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CONTENTS

Page

A Study of the Personal-Social and Intellectual Characteristics of a Group of State College Students Preparing to Teach *Lester Dale Vertein* 159

A Study of the Influence of Variables on Group Data *Arthur R. DeLong* 193

Pressure on Point and Barrel of a Writing Instrument *Virgil E. Herrick and Wayne Otto* 215

A Study of Relationships Between Child Rearing Attitudes and Maternal Behavior *Michael Zunich* 231

The Development of a First-Grade Adjustment Scale *Gene R. Medinnus* 243

A Study of Achievement as a Function of Homogeneous Grouping *William F. Koontz* 249

The Influence of Mental Ability on Achievement When Socio-Economic Status is Controlled *Robert L. Baker, Richard E. Schutz and Richard H. Hinze* 255

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A STUDY OF THE PERSONAL-SOCIAL AND INTELLECTUAL CHARACTERISTICS OF A GROUP OF STATE COLLEGE STUDENTS PREPARING TO TEACH

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SECTION I

Statement of Problem

THE PURPOSE of this study is to seek information about the personal-social and intellectual characteristics of students preparing to teach in a Wisconsin state college. It is hoped that the study will provide information not merely about the characteristics of the students at any given time, but information about the stability of the data collected with reference to these characteristics and how they are interrelated. The answers to three questions were sought regarding the personal-social, intellectual, and achievement characteristics of the subjects:

1. What are the personal-social, intellectual, and achievement characteristics of students preparing for teaching at a Wisconsin state college?
2. What stability does one find in such data as shown by a retest program?
3. Are there any patterns in the abilities and characteristics of Wisconsin state college students as shown by correlational analysis of test scores?

Importance of the Problem

Interest continues to grow among professional and lay persons concerning characteristics of teachers. The problem of preparing efficient teachers faces every teacher-training institution. In order that these institutions can more effectively organize the teacher-training curriculum, it would seem advisable to obtain more precise information relative to the characteristics of students in colleges preparing to teach, such as the relationships and stability of certain personal-social and intellectual characteristics. Eventually one will desire to know how these characteristics are related to certain aspects of teacher competency. Programs of selection, recruitment, and education need a substantial factual foundation.

It is common observation that students differ greatly in personal-social characteristics. The recognition of the personal-social characteristics as an important aspect of learning was pointed out by Havighurst and Neugarten (18). They indicated the areas in which the investigation of personal-social and intellectual behavior may be profitably pursued: "the college in the social structure, education and social policy, social origins and social roles of teachers."

In any study of prospective teachers there is need of a psychology that provides adequate recognition of personal-social, intellectual, and achievement characteristics. Sims (33) has shown some positive correlations of social class identification among high-school and college students, i. e., social class identification has a significant relationship to plans for further education. Social class structure is positively related to success which is based on general mental ability, largely verbal. In planning teacher education, it is of educational importance to know with which social class a student identifies. Every psychological event depends upon the state of the person and at the same time on the environment. The experimental work of recent years shows more and more this twofold relationship in all fields of psychology. Every scientific psychology must take into

*Special recognition is due to the members of my thesis committee: Dr. A. S. Barr, my major professor, Dr. Helen Dawe, Dr. H. J. Klausmeier, and Dr. Edward Krug, all of whom provided me with the benefit of their helpful criticisms and suggestions.

account the whole situation such as the personal-social, intellectual, and achievement characteristics of the individual relative to his social environment.

SECTION II

Design of the Study

THE DESIGN of this investigation is quite simple. Basically it is a study of status and of the interrelationships among qualities thought to be related to teacher effectiveness.

The Setting

The subjects for this investigation came from a course in educational psychology taught by the author. Educational Psychology is one in a sequence of courses required of all students at Wisconsin State College and Institute of Technology at Platteville preparing to teach in the secondary school. The Wisconsin State College and Institute of Technology at Platteville will hereafter be referred to as WSCITP. The emphasis of the course is upon the nature and direction of learning. It is a second semester sophomore course and the first professional education course for these students. Observation in the laboratory school is a part of the course. A prerequisite to the course is General Psychology, a first semester sophomore course which deals with the understanding of the nature of man and early childhood. It is a general education course and is required of all students except those in the technology division.

The breadth of course material was controlled by the use of a common group of outside readings and common course assignments. All classes were assigned the same required text and supplementary readings prior to common six weeks, nine weeks, and twelve weeks tests. A common final examination was administered to students of all classes at the same time in the same classroom.

The four classes were conducted in the same manner by the same teacher. Their main instructional activities included: lectures, whole class discussions, small group discussions and planning, teacher and student demonstrations, films, student panels, student reports, and tests.

The Subjects

The subjects were 114 students, 88 who were enrolled in a sophomore course in educational psychology the second semester of the 1957-58 academic year, and another 26 students who were enrolled in the same course the first semester of the 1958-59 academic year. Those students still enrolled at WSCITP during the second semester of the 1959-60 academic year were retested.

One hundred fourteen students completed the full semester's work in Educational Psychology 223. This was considered as the total population. Sixty-three of those enrolled in the second semester of the 1957-58 academic year, and 19 of those enrolled in the first semester of the 1958-59 academic year attended WSCITP the second semester of the 1959-60 academic year.

It was decided to study only those students for whom there was complete background information and who were still enrolled at WSCITP during the 1959-60 academic school year. The educational and personal histories were secured directly from the students themselves, therefore this information was available for all students. It was possible to secure all other information from these students by scheduled make-up periods if any one was absent when a test or inventory was administered.

Complete records and retest data were available for 63 of the 88 students. Thirteen students graduated; three were dropped from college for poor scholastic records; three withdrew; four transferred to other schools, and two entered the armed services from the classes of the academic year of 1957-58.

Complete records and retest data were available for 19 of the 26 students of the class of the academic year of 1958-59. Two students graduated; three withdrew; one transferred to another school, and one entered the armed services.

Complete records and retest data were available for 82 students. These 82 students formed the study population.

Population Described

Of the 82 student study population, 12 (15%) were females and 70 (85%) were males. The nonacademic population was composed of 2 (4%) females and 43 (96%) males, while the academic students had 10 (27%) females and 27 (73%) males (Table I).

A majority of the students were single. In the total study population 61 (74%) were unmarried, 19 (23%) married, 1 (1%) divorced, and 1 (1%) widowed. Thirty-three (73%) of the nonacademic population were single, 11 (24%) married, and 1 (2%) were widowed. Twenty-eight (76%) of the academic students were single, 8 (22%) married, and 1 (2%) divorced (Table I).

The number of veterans was small. There were 24 (29%) in the study population, 14 (31%) in the nonacademic population, and 10 (23%) in the academic population (Table I).

Students at WSCITP need 30-59 credits to be classified as second-year students, and 60-89 credits to be classified as third-year students. Sixty-one (74%) of the total study population were second-year students and 21 (26%) were third-year

TABLE I

STUDENTS GROUPED BY SEX, MARITAL STATUS, MILITARY SERVICE, AND COLLEGE CLASSIFICATION

	Students Grouped by Sex					
	Total Study Population		Nonacademic Population		Academic Population	
Sex	N	%	N	%	N	%
Female	12	15	2	4	10	27
Male	70	85	43	96	27	73

	Students' Marital Status					
Marital Status	Total Study Population		Nonacademic Population		Academic Population	
Single	61	74	33	73	28	76
Married	19	23	11	24	8	22
Divorced	1	1	0	--	1	2
Widowed	1	1	1	2	0	--

	Students' Military Service					
Military Service	Total Study Population		Nonacademic Population		Academic Population	
Nonveteran	58	71	31	69	27	73
Veteran	24	29	14	31	10	23

	College Classification					
Years of Study	Total Study Population		Nonacademic Population		Academic Population	
1	0	--	0	--	0	--
2	61	74	39	87	22	59
3	21	26	6	13	15	41
4	0	--	0	--	0	--

students. The nonacademic were quite different from the academic in years of study. Thirty-nine (87%) of the nonacademic students were second-year students, and 21 (59%) of the academic students were in their second year of study (Table I).

Students of the study population had primary majors in 10 subjects. Agricultural education was the most common primary major of the study population. Twenty-nine (35%) were agricultural education majors, 14 (17%) industrial arts majors, 11 (13%) history majors, 9 (11%) English majors, 8 (10%) biological science majors, 7 (9%) mathematics majors, and 1 (1%) in each of the following: chemistry, elementary education, music, and physics (Table II).

The subjects in which students were majoring were classified into academic-nonacademic areas along the Hutchins' line as done in Carter Good's Dictionary of Education (15). Seven subject areas were defined within this classification.

Academic subjects were divided into three areas:

1. Language—English, French, Spanish, Russian
2. Science-Mathematics—Natural Science, Biology, Physics, Mathematics
3. Social Sciences—History, Political Science, Geography, Sociology, American Institutions

Nonacademic subjects were divided into four areas:

1. Arts—Art, Music
2. Vocational Education—Agriculture, Home Economics, Industrial Arts, Business Education
3. Physical Education—Physical Education
4. Miscellaneous—Journalism, Speech, Speech Correction, Recreation, Elementary Education

This division into subject areas was done so that a better comparison could be made between the nonacademic and academic populations. It was felt that the academic students would do better in educational psychology than the nonacademic students.

Forty-five (55%) of the study population were majoring in nonacademic subjects, 37 (45%) in academic subjects.

The total study population was quite heterogeneous as to the size of community in which the students lived when they attended high school. The following are community sizes: farm 36 (44%); village under 500, 14 (17%); 500-2500, 14 (17%); 2501-10,000, 10 (12%); 10,001-39,000, 4 (5%); 39,001-150,000, 3 (4%); and over 150,000, 1 (1%). Only 8 (10%) of the students had lived in communities of over 10,000 when they attended high school. The majority of the nonacademic population, 25 (56%), have lived on farms. Twenty-nine (65%) of this group have chosen agricultural education as their major field of study. The majority of the academic students, 11 (30%), came from farms, and 10 (27%) came from villages under 500 (Table III).

The total study population was very heterogeneous as to the size of high-school graduating class. A minority, 17 (21%), of the graduating classes were over 100. The nonacademic and academic were similar in this respect to the total population with 9 (20%) and 8 (22%) respectively (Table III).

The youngest student of the total study population was 19 years old, the oldest 38. The majority, 52 (63%), were 22 and under.

Twenty-nine (65%) of the nonacademic students were 22 years of age or under, 23 (63%) of the academic students were 22 and under. The mean age for the study population was 22.22 years of age. The nonacademic mean was 22.18. The academic mean was 22.27 (Table IV).

The formal educational status of the parents of the study population was not high. Of the mothers 5 (6%) did not finish the elementary grades; 38 (46%) were elementary graduates; 18 (22%) graduated from high school; 19 (23%) attended college but did not earn a degree, and 2 (2%) graduated from college with a degree. The mothers of the nonacademic and academic students followed a similar pattern. Educational status of the fathers was different from the mothers. Ten (12%) did not finish the elementary grades, 47 (57%) were elementary graduates, 21 (26%) graduated from high school, 2 (2%) attended college but did not earn a degree, and 2 (2%) graduated from college with a degree. The fathers of the nonacademic and academic students followed a similar pattern. More fathers than mothers did not finish the elementary grades. More fathers than mothers were elementary graduates. The number of mothers and fathers who were high-school graduates was about equal. A much larger percentage of mothers than fathers attended college, but did not earn a degree. The population has come from homes of rather limited educational opportunities (Table V).

A majority of the study population, 48 (59%), were partially self-supporting. Twenty-nine (35%) were completely self-supporting. Only 5 (6%) were completely supported by their parents. The nonacademic and academic students showed a similar pattern to the total study population. These students seem to have come from families of limited financial status (Table VI).

In the total study population, 45 (55%) of the students were majoring in nonacademic areas, 37 (45%) in academic areas.

The personal-social, intellectual, and achievement characteristics studied included the many characteristics, present or absent, in a given sit-

TABLE II

NUMBER OF STUDENTS ENROLLED IN MAJOR FIELDS OF STUDY

Major Fields	N	%
	Nonacademic Population	
Agriculture	29	35
Industrial Arts	14	17
Elementary Education	1	1
Music	1	1
	45	
	Academic Population	
History	11	13
English	9	11
Biological Science	8	10
Mathematics	7	8
Chemistry	1	1
Physics	1	1
	37	
Total Number	82	

TABLE III

TYPES AND SIZE OF HIGH SCHOOLS ATTENDED

	Types of High Schools Attended					
	Total Study Population		Nonacademic Population		Academic Population	
Classification	N	%	N	%	N	%
Farm	36	44	25	56	11	30
Village under 500	14	17	4	9	10	27
500 - 2,500	14	17	5	11	9	24
2,501 - 10,000	10	12	7	16	3	8
10,001 - 39,000	4	5	1	2	3	8
39,001 - 150,000	3	4	2	2	1	3
Over 150,000	1	1	1	2	0	--
	82		45		37	

	Size of High-School Graduating Class					
	Total Study Population		Nonacademic Population		Academic Population	
Classification						
25 and less	19	23	10	22	9	24
26 - 50	20	24	8	18	12	32
51 - 75	13	16	9	20	4	11
76 - 100	13	16	9	20	4	11
Over 100	17	21	9	20	8	22
	82		45		37	

TABLE IV

DISTRIBUTION OF STUDENTS' AGES

Age in Years	Total Study Population		Nonacademic Population		Academic Population	
	N	%	N	%	N	%
19	4	5	0	--	4	11
20	31	38	23	51	8	22
21	7	8	3	7	4	11
22	10	12	3	7	7	19
23	8	10	5	11	3	8
24	6	7	2	4	4	11
25	5	6	4	9	1	3
26	6	6	2	4	4	11
27	0	--	0	--	0	--
28	4	5	2	4	2	5
Over 28	1	1	1	2	0	0
Number	82		45		37	
Mean	22.22		22.18		22.27	
22 or under		63		65		63
23 or over		37		35		37
Range	19-38		20-38		19-28	

TABLE V

EDUCATION OF THE PARENTS OF STUDENTS

Education of the Mothers of Students

Educational Status	Total Study Population		Nonacademic Population		Academic Population	
	N	%	N	%	N	%
Not an Elementary School Graduate	5	6	4	11	1	3
Elementary School Graduate	38	46	19	42	19	51
High-School Graduate	18	22	10	22	8	22
Attended College but did not earn degree	19	23	11	24	8	22
College Graduate	2	2	1	2	1	3
	82		45		37	

Education of the Fathers of Students

Educational Status	Total Study Population		Nonacademic Population		Academic Population	
Not an Elementary School Graduate	10	12	9	20	1	3
Elementary School Graduate	47	57	22	49	25	68
High-School Graduate	21	26	12	27	9	24
Attended College but did not earn degree	2	2	1	2	1	3
College Graduate	2	2	1	2	1	3
	82		45		37	

TABLE VI

FINANCIAL STATUS OF COLLEGE STUDENTS

Financial Status	Total Study Population		Nonacademic Population		Academic Population	
	N	%	N	%	N	%
Completely Self-Supporting	29	35	15	33	14	38
Partially Self-Supporting	48	59	27	60	21	57
Completely Supported by Parents	5	6	3	7	2	5
Number	82		45		37	

uation that may influence the students' achievement. A potentially retarding situation may be present or absent but a particular student, because of his personal-social, intellectual, and achievement background, may not be retarded by it. Even though students vary greatly in their college achievement, it would seem desirable to ascertain the personal-social and intellectual characteristics which seem to influence achievement.

A follow-up was made during the 1959-60 academic year to measure the retention of basic facts, skills and concepts developed by the students and the effective application of these facts, skills and concepts. The stability of attitudes was formed by a retest program. Selected achievement tests and an attitude inventory were administered to those students still enrolled at WSCITP during the second semester of the 1959-60 academic year.

Data-Gathering Devices and Data Collected

Data-gathering devices for personal-social characteristics used in this investigation were: a nineteen-page data booklet to identify personal-social characteristics, including family background and current interests, the "K" score of the Minnesota Multiphasic Personality Inventory measures student emotional stability and test taking attitude, the Minnesota Teacher Attitude Inventory to measure those attitudes of a teacher which will predict how well he will get along with pupils in interpersonal relationships, and indirectly how well satisfied he will be with teaching as a vocation, and a ten-item attitudes scale to measure student attitude toward the course and method of instruction.

Personal-social characteristics were considered to be measured first by "K" scores achieved on the Minnesota Multiphasic Personality Inventory, hereafter referred to as the MMPI. According to Gowan (16:208-12) the "K" score predicts teaching potential. Cottle used the individual form alternately with the group form for test and retest. Both testings occurred within one week. The reliability coefficient for the "K" score was .76 (17:5-7).

Personal-social characteristics were considered to be measured also by scores achieved on the Minnesota Teacher Attitude Inventory, hereafter referred to as the MTAI. The MTAI was designed to measure those attitudes of a teacher which predict how well he will get along with pupils in interpersonal relationships, and indirectly how satisfied he will be with teaching as a vocation. The validity was determined by a study correlating the MTAI with the Pupil-Teacher Rating Scale, the Principal-Teacher Rating Scale, and Baxter's Rating Scale of Teacher's Personal Effectiveness. When the three criteria were combined with multiple regression weighting, the validity coefficient was .60 (8:10-12).

Personal-social characteristics were considered to be measured also by scores on a ten-item attitude scale. This scale measured student attitude toward the course and method of instruction. The coefficient of equivalence of the scale was found, by a modified form of the Cronbach-Hoyt method, to be .74 (12:50).

Intellectual characteristics with which the investigation was concerned were those indicated by test scores on the California Test of Mental Maturity Advanced 1957 S-Form, hereafter referred to as the CTMM. The 1957 Edition of the California Short-Form Test of Mental Maturity, Advanced, is the result of over twenty years of research and development. Millions of individuals have been tested and hundreds of studies have been made, either utilizing the Short-Form as a control or probing some aspect of its use. The validity of the CTMM and Short-Form is further verified by its high correlation with the Wechsler-Bellevue. Clark reports a correlation of .81 between the CTMM and Wechsler-Bellevue (36:5-6).

Achievement characteristics were considered to be, percentile rank, as indicated by the students' position in high-school graduating class, the students' knowledge of basic facts, skills, and concepts to be learned in educational psychology and their effective application to teacher-learner situations, as measured by scores on achievement tests, and college grade-point average, including total general education and major field of study.

Three elements of the experiment, namely the personal-social, intellectual, and achievement characteristics, will be discussed in greater detail below.

At the beginning of the semester a 19-page Data Booklet, a mimeographed booklet developed by the Teacher Research Committee of the University of Wisconsin, School of Education, was passed out to the students. They were informed that the information would be confidential and would be used for research purposes only. Under no conditions would this information be available to other teachers or employment officials. This was to be completed by the next class period.

At the end of the twelfth week of the semester, the MMPI was administered. Students were told that this inventory would have no influence upon their grades. Each one was encouraged to respond rapidly and honestly to each item. Two 50-minute classes were needed to complete the inventory.

At the end of the fifteenth week of school the MTAI was administered. Students were told that this would measure attitude toward student relationships and attitude toward teaching as a vocation. This would not distinguish a good teacher from a poor one, nor would the results have any influence upon their grades.

Personal-social characteristics of all students

were measured by a ten-item mimeographed attitudes scale which was developed at the University of Wisconsin. This scale was administered on the last day of classes. The scale measured student attitudes toward the course and method of instruction. All responses were anonymous. It was hoped that such administration would encourage students to respond honestly. Students were given fifteen minutes to complete the inventory.

Intellectual characteristics were measured during the tenth week of the semester by scores on the verbal part of the CTMM. The students were informed of the limitations and shortcomings of this test when it is administered to college students.

Achievement characteristics were defined as, percentile rank in high-school graduating class, a battery of achievement tests, a judgment test, and college grade-point average.

Percentile rank in high-school graduating class was computed for each student. This information was obtained from the Registrar's office at WSCITP.

A battery of tests was used to measure achievement in educational psychology. All classes were assigned certain common required readings in six books. The test for Educational Psychology was Educational Psychology by Lee J. Cronbach (9). Five references were used which included: Educational Psychology by William A. Fullagar (14); National Society for the Study of Education; Learning and Instruction, 49th Yearbook, Part I (26); Psychology and Life by Floyd L. Ruch (29); and Readings in Educational Psychology by Jerome M. Seidman (32). The following reading assignments were required of all classes; the entire Cronbach text; fifteen articles in Coladarci's collection and the same number in Fullagar; eight from the National Society for the Study of Education; four from Ruch; and nine from Seidman. The five references were placed on course reserve in the library and were used for instructional and testing purposes by all classes in common.

Eight instruments were used to measure student achievement in educational psychology.

Six objective tests were used to measure student knowledge of basic course facts and concepts.

The pretest was a 45-item multiple-choice test developed by the Education 75 staff of the University of Wisconsin. The coefficient of equivalence of the test as determined by the modified form of the Kuder-Richardson 20 formula was . 36 (12:47). These items were presumed to cover the textbook. There were no items on supplementary readings, nor were the items of a highly technical nature. The test was administered at the third class meeting of the semester. Students were permitted to use the entire fifty-minute period to complete the test.

The final examination was a 73-item multiple-choice test. The first 45 items were identical to the 45 pretest items. Twenty-eight items, covering the required supplementary readings, were added. These 28 items were drawn from the pool of items developed by the Education 75 staff of the University of Wisconsin. This 73-item objective test was one-half of the final examination. During the second semester of the academic school year of 1959-60, this 73-item objective test was administered again to those students still enrolled at WSCITP. Special evening hours were scheduled for the convenience of the students. Students were permitted sixty minutes to complete this part of the retest.

The Sears Level of Aspiration Test was administered on the assigned Pauline Sears' article in Coladarci. A mimeographed study guide, which was developed by the staff at the University of Wisconsin, was given students to aid them in the study of this article. A week later students were given a ten-item true-false test. Students were permitted fifteen minutes to complete the test. During the second semester of the academic school year of 1959-60 this ten-item objective test was administered again to those students still enrolled at WSCITP.

The six weeks' test was a 44-item multiple-choice test developed by the staff of the University of Wisconsin. These items tested the material covered in the textbook during the six weeks' period and were of a technical nature. The test was administered at the end of the six weeks' period. Students were permitted fifty minutes to complete the test.

The nine weeks' test was an 80-item multiple-choice test developed by the Psychological Services, Inc. These items tested four assigned chapters on learning in the reference by Ruch (29) and were of a highly technical nature. The test was administered at the end of the nine-week period. Students were permitted fifty minutes to complete the test.

The twelve weeks' test was a 63-item multiple-choice test developed by the Education 73 staff of the University of Wisconsin. The material covered in the textbook during this period was tested by these items, which were of a technical nature. The test was administered at the end of the twelve week period. Students were permitted fifty minutes to complete the test.

One instrument was used to measure application of course skills and concepts to teacher-learner situations. The Judgment Test was a test devised to measure professional judgment (30). The coefficient of equivalence of the test, as determined by the Spearman-Brown step-up formula for split halves, was . 76 (12:49). The data sheet for the test was passed out to the students for home study one class period prior to the test. Students were informed that the test would be based on data distributed but no indication was

given as to how the data would be used. The same data sheet was distributed the day of the test with ten judgment items based on the data. Fifty minutes were given to write this test. During the second semester of the academic school year of 1959-60, this Judgment Test was re-administered to those students who were still enrolled at WSCITP. Students were permitted fifty minutes to complete the test.

The grade-point average in general education, major field of study, and total grade-point average was figured for these students at the end of three semesters in college. Data were collected from the records of the Registrar's Office at WSCITP. These grade-point averages were again computed during the academic school year of 1959-60 or at the end of seven semesters in college.

SECTION III

Introduction

THE PURPOSE of this study, as stated in Section I, is to seek information about the personal-social and intellectual characteristics of students preparing to teach in a Wisconsin state college. It is hoped that the study will provide information not merely about the characteristics of students at any given time, but information about the stability of the data collected with reference to these characteristics and how they are interrelated. The following three questions were asked:

1. What are the personal-social, intellectual, and achievement characteristics of students preparing for teaching at a Wisconsin state college?
2. What stability does one find in such data as shown by a re-test program?
3. Are there any patterns in the abilities and characteristics of Wisconsin state college students as shown by correlational analysis of test scores?

Personal-Social Characteristics

Personal-social characteristics were measured by three measuring devices.

One device used to measure the personal-social characteristics of the study population was the "K" score of the MMPI. These findings were expressed in mean scores and standard deviations.

The study population mean score was 15.79. Nonacademic students earned a mean score of 16.22. The academic students had a mean score of 15.27 (Table VII). The highest possible score is 30. WSCITP students' scores ranged from 4-25.

The distribution of the "K" scores on the MMPI was shown by one-half standard deviations. Sixty-six (82%) of the study population fell within one standard deviation of the mean. Thirty-eight (85%) of the nonacademic students fell within one standard deviation of the mean, and twenty-eight (77%) of the academic population fell within one standard deviation of the mean (Table VII).

Another device used to measure the personal-social characteristics of the study population was the MTAI. These findings were expressed in mean scores and standard deviations.

The study population earned a mean score of 22.87. The mean score of the nonacademic population was 15.33. The mean score for the academic population was 32.03 (Table VIII). Of the total study population, 65 (79%) fell within one standard deviation of the mean. The nonacademic showed greater homogeneity; 38 (84%) fell within one standard deviation of the mean. Twenty-seven (73%) of the academic fell within one standard deviation of the mean (Table VIII).

During the 1959-60 academic school year, the MTAI was re-administered to those students still enrolled in WSCITP to determine what stability might exist in the teacher-student attitude.

The study population earned a mean score of 31.30. The mean score of the nonacademic population was 30.25. The mean score of the academic population was 32.57 (Table VIII). Of the total study population, 69 (84%) fell within one standard deviation of the mean. The academic showed greater homogeneity on the retest with 34 (92%) within one standard deviation of the mean. Thirty-five (78%) of the nonacademic fell within one standard deviation of the mean.

The scores achieved by the WSCITP students on the MTAI were compared with the norms of MTAI (8). This scoring was right minus wrong. Negative scores were possible. The vast majority of the WSCITP students were second semester sophomores during the academic year of 1957-58 (Table I). The mean scores of nonacademic and academic population were below the MTAI norms. The standard deviations of both WSCITP populations were below the MTAI norms (Table VIII).

Most of these WSCITP students were graduating seniors during the 1959-60 academic year (Table I). The mean scores of nonacademic and academic appeared to be farther below the MTAI norms than they were during the 1957-58 academic year. The standard deviation was greater for the MTAI norms than for the WSCITP nonacademic population. The standard deviation was less for the MTAI norms than for the WSCITP academic population (Table VIII).

The last device used to measure personal-social characteristics of the students was a 10-item objective attitude scale. This scale had been given to the 114 students, the total population. Students did not sign their names, but indicated their primary major. There was no way to identify the study population. It was therefore necessary to use the total population. These findings

TABLE VII

DISTRIBUTION OF STUDENTS' MINNESOTA MULTIPHASIC PERSONALITY INVENTORY "K" SCORES

	Total Study Population		Nonacademic Population		Academic Population	
MMPI "K" Scores	N	%	N	%	N	%
Under 5.22	2	2	0	--	2	5
5.22- 7.56 (-2 S.D.)	3	4	1	2	2	5
7.57- 9.91 (-1½ S.D.)	1	1	1	2	0	--
9.92-12.26 (-1 S.D.)	12	15	7	16	5	14
12.27-14.61 (-½ S.D.)	16	20	9	20	7	19
14.62-16.96	12	15	5	11	7	19
16.97-19.31 (+½ S.D.)	14	17	9	20	5	14
19.32-21.66 (+1 S.D.)	12	15	8	18	4	11
21.67-24.01 (+1½ S.D.)	9	11	4	9	5	14
24.02-26.36 (+2 S.D.)	1	1	1	2	0	--
Number	82		45		37	
Mean	15.79		16.22		15.27	
S.D.	4.69		4.18		5.18	
Range	4 - 25		7 - 25		4 - 24	

TABLE VIII

COMPARISON OF MEAN SCORES OF WSCITP STUDENTS WITH THE NORMS OF THE MTAI

	Total Study Population	Nonacademic Population	Academic Population
	WSCITP Students MTAI Scores 1957-58		
Number	82	45	37
Mean	22.87	15.33	32.03
S. D.	26.47	24.66	25.89
	WSCITP Students MTAI Scores 1959-60		
Number	82	45	37
Mean	31.30	30.25	32.57
S. D.	26.63	26.49	26.69

	Norms for the MTAI			
	Beginning Education Juniors		Graduating Education Seniors (B. Ed.)	
	Non-Academic	Academic	Non-Academic	Academic
Number	238	136	185	237
Mean	44.1	48.3	63.0	67.8
S. D.	27.1	29.2	33.3	24.3

TABLE IX

MEANS OF WISCONSIN EDUCATION 75 STUDENTS AND WSCITP STUDENTS ON THE ATTITUDE SCALE

	Education 75 Students (156)	WSCITP Students (114)	WSCITP Nonacademic Students (76)	WSCITP Academic Students (38)
Mean	20.2	26.8	25.9	28.4
Five Methods Item Mean	8.7	12.2	11.5	13.4
Five Content Item Mean	11.5	14.6	14.4	15.0

were expressed in mean scores (Table IX). The mean score of the total population was 26.76. The mean score of the nonacademic students was 25.76. The academic students received a higher mean score of 28.41.

On the five items of the inventory which referred to attitude toward instructional methods used in the course, the academic mean score of 13.42 was higher than the nonacademic mean score of 11.55. The mean score of the total population was 12.18. On the other five items of the inventory which measured attitude toward the course, the academic mean score of 14.99 was little higher than the nonacademic mean score of 14.37. The mean of the total population was 14.58. Both populations seemed less satisfied with the methods by which the course material was presented than with the material itself.

Intellectual Characteristics

Intellectual characteristics of the study population were measured with the CTMM. These findings were expressed in mean scores and standard deviations.

The mean score of the study population was 112.96. The nonacademic had a mean score of 110.47. The higher mean score, 116.00, was achieved by the academic students. The standard deviation for the total study population was 10.38. The standard deviation for the nonacademic was 8.87, and for the academic population 11.12 (Table X).

Achievement Characteristics

Achievement characteristics were considered to be percentile rank in high-school graduating class, a battery of achievement tests, a judgment test, and college grade-point average.

One measure of achievement was percentile rank in high-school graduating class. Of the total study population the mean was 57.09. The mean of the nonacademic students was 51.27 and the mean of the academic students was 64.16. The standard deviations were as follows: total study population 21.75, nonacademic population 20.21, and academic population 21.49. Of the total population 57 (69%) were within one standard deviation of the mean. Thirty-three (73%) of the nonacademic and 24 (65%) of the academic population were within one standard deviation of the mean (Table XI).

Another measure was a total achievement score earned on the battery of tests given during the semester to the author's students in a course in educational psychology: a 73-item objective test, a 10-item objective test, a six-weeks 44-item objective test, a nine-weeks 80-item objective test, and a twelve-weeks 63-item objective test. These tests were designed to test the students' general knowledge of educational psychology facts and concepts as developed in the textbook and in the classroom, as well as to test the students' knowledge of facts and concepts presented in the required outside readings. These tests were presumed to have curricular validity in that they tested the common course objectives of educational psychology.

The highest possible total achievement score was 270. The findings were expressed in mean scores and standard deviations.

The mean score of the study population on these 270 items was 142.41. The academic mean was higher, 149.84, than the nonacademic mean of 136.31. The standard deviations are as follows: total study population 21.10, nonacademic 19.94, and academic 19.96 (Table XII).

Of the total study population, 67 (81%) were distributed within one standard deviation of the mean. Thirty-eight (84%) of the nonacademic students were within one standard deviation of the mean. Twenty-nine (78%) of the academic students were within one standard deviation of the mean.

The Judgment Test was another measure of achievement, which was devised to measure professional judgment. This test was administered to the student population with the understanding that this score would be used to determine semester grades. For all students, it was a learning experience and a test which would determine, to some extent, semester grades. The mean score of the total study population was -22.68. The mean score of the nonacademic students was -23.69. The academic mean score was -21.46. The standard deviations were as follows: total study population 38.44, nonacademic 36.18, and academic 41.02 (Table XII). The nonacademic population had more consistent intraclass student performance than the academic population as shown by standard deviations (Table XII).

The last measure of achievement was college grade-point average. The grade-point averages were computed for total credits, general education, and major field of study. These were the students' grade-point averages at the completion of seven semesters of college work. Grade-point average was based on a four-point scale: 4 grade-points being given for each credit of A work, 3 for B work, 2 for C, 1 for D, and 0 for failures or incompletes.

The total mean grade-point average was higher for the academic 2.55 than for the nonacademic 2.49. The nonacademic showed more homogeneity. The standard deviation for the nonacademic was .44 and for the academic .55. Forty (89%) of the nonacademic and 26 (70%) of the academic were within one standard deviation of the mean (Table XIII).

The academic population had a higher mean general education grade-point average of 2.41,

TABLE X

DISTRIBUTION OF CALIFORNIA TEST OF MENTAL MATURITY ADVANCED 1957-S FORM SCORES

IQ Scores	Total Study Population		Nonacademic Population		Academic Population	
	N	%	N	%	N	%
89.61- 94.79 (-2 S.D.)	0	--	0	--	0	--
94.80- 99.98 (-1½ S.D.)	7	8	5	11	2	5
99.99-105.17 (-1 S.D.)	13	16	8	18	5	14
105.18-110.36 (-½ S.D.)	25	30	15	33	10	27
110.37-115.55	5	6	4	9	1	3
115.56-120.74 (+½ S.D.)	16	20	8	18	8	22
120.75-125.93 (+1 S.D.)	6	7	2	4	4	11
125.94-131.12 (+1½ S.D.)	3	4	1	2	2	5
131.13-136.31 (+2 S.D.)	6	7	2	4	4	11
136.32 and over	1	1	0	--	1	3
Number	82		45		37	
Mean	112.96		110.47		116.00	
S. D.	10.38		8.87		11.12	
Range	96-144		96-135		97-144	

TABLE XI

DISTRIBUTION OF STUDENTS' PERCENTILE RANK IN HIGH-SCHOOL GRADUATING CLASS

	Total Study Population		Nonacademic Population		Academic Population	
Percentile Rank	N	%	N	%	N	%
8.18-19.04 (-2 S.D.)	3	4	2	4	1	3
19.05-29.91 (-1½ S.D.)	9	11	7	16	2	5
29.92-40.78 (-1 S.D.)	10	12	7	16	3	8
40.79-51.65 (-½ S.D.)	10	12	8	18	2	5
51.66-62.52	15	18	7	16	8	22
62.53-73.39 (+½ S.D.)	15	18	7	16	8	22
73.40-84.26 (+1 S.D.)	7	8	4	9	3	8
84.27-95.13 (+1½ S.D.)	13	16	3	7	10	27
95.14-99.99 (+2 S.D.)	0	--	--	--	0	--
Number	82		45		37	
Mean	57.09		51.27		64.16	
S. D.	21.75		20.21		21.49	
Range	11-94		14-94		11-94	

TABLE XII

MEAN ACHIEVEMENT SCORES

	Total Study Population	Nonacademic Population	Academic Population
	Total Achievement: 270 Items		
Number	82	45	37
Mean	142.41	136.31	149.84
S. D.	21.10	19.94	19.96
	Class Achievement-Judgment Test		
Number	82	45	37
Mean	- 22.68	- 23.69	- 22.68
S. D.	38.44	36.18	41.02

TABLE XIII

DISTRIBUTION OF STUDENTS' TOTAL GRADE-POINT AVERAGE AT THE END OF SEVEN SEMESTERS IN COLLEGE

College Grade-point Average	Total Study Population		Nonacademic Population		Academic Population	
	N	%	N	%	N	%
1.40-1.64 (-2 S.D.)	0	--	0	--	0	--
1.65-1.89 (-1½ S.D.)	7	8	2	4	5	14
1.90-2.14 (-1 S.D.)	13	16	7	16	6	16
2.15-2.39 (-½ S.D.)	21	26	14	31	7	19
2.40-2.64	9	11	8	18	1	3
2.65-2.89 (+½ S.D.)	14	17	5	11	9	24
2.90-3.14 (+1 S.D.)	9	11	6	13	3	8
3.15-3.39 (+1½ S.D.)	3	4	1	2	2	5
3.40-3.64 (+2 S.D.)	4	5	1	2	3	8
3.65 and over	2	2	1	2	1	3
Number	82		45		37	
Mean	2.52		2.49		2.55	
S. D.	.48		.44		.55	
Range	1.76-3.91		1.81-3.91		1.76-3.68	

than the nonacademic population of 2.14. Thirty-seven (82%) of the nonacademic and 31 (84%) of the academic were within one standard deviation of the mean. These two groups were quite homogeneous in regard to distribution of grade-point average in general education (Table XIV).

The nonacademic had a higher mean major study grade-point average of 2.85, than the academic of 2.50. The nonacademic appeared more homogeneous in distribution of grade-point average in the major field. Thirty-nine (85%) of the nonacademic population were within one standard deviation of the mean. In the academic population, 24 (66%) were within one standard deviation of the mean (Table XV).

Stability of Data as Shown by Retest

At WSCITP, 88 students were enrolled in a sophomore course in educational psychology the second semester of the 1957-58 academic year, and 26 students were enrolled in the same course the first semester of the 1958-59 academic year. Eighty-two of the 114 students were still enrolled at WSCITP during the second semester of the 1959-60 academic year. These 82 students were considered as the total study population.

Two tests and one attitude inventory were readministered to these 82 students during the second semester of the 1959-60 academic year to show the stability one might find in such data. The product moment coefficient of correlation (Pearson r) was found between the original scores and the retest scores.

One test that was readministered was the 73-item objective examination that had been used as part of the final examination in the educational psychology classes.

In looking at the coefficient of correlation resulting from correlating the original test scores with the retest scores we see greater stability within the nonacademic population. The value of r = .83 was found. For the academic population the value of r = .67. The value of r = .65 was found for the total study population (Table XVI).

The Judgment Test which was one of the tests used in grading students in educational psychology was readministered to those 82 students still enrolled at WSCITP during the second semester of the 1959-60 academic year.

The coefficient of correlation resulting from correlating the original test score with the retest scores showed greater stability within the academic population. The value of r = .52 was found for the academic students. For the nonacademic population r = .35. For the total study population r = .43 (Table XVII).

The MTAI was used in educational psychology to demonstrate the different attitudes that teachers may have toward students. Items in the inventory discriminate sharply between teachers who have and those who do not have good rapport with students. The students were told to answer all items honestly, as this was to be a learning experience, and the MTAI scores would not be used to determine semester grades.

The coefficient of correlation between the two test periods was highest for the nonacademic population. The coefficient of correlation was found to be r = .64. The academic population had a much lower correlation. The value of r = .23 was found. For the total study population the value of r = .44 (Table XVIII).

Patterns Shown by Wisconsin State College Students

Intelligence, as measured by CTMM scores, correlated relatively high with achievement, as measured by total test scores in educational psychology. Other high correlations with intelligence were general education grade-point average, percentile rank in high-school graduating class, and total grade-point average. The correlations were higher for the academic than the nonacademic. The academic showed a correlation of .71 between intelligence and general education. For the nonacademic this value of r = .34, and for the total population the value of r = .60. This is to be expected as the courses in general education use many of the same abilities which are needed to score high on a verbal test. A commonly conceived idea is that the academic student usually has greater potential in these areas than the nonacademic.

The correlation between intelligence and grade-point average in major field of study suggests heterogeneity between the nonacademic and academic population. The values of r are as follows: total study population .26, nonacademic population .44, and the academic population .57.

For the study population the correlation between intelligence and the Judgment Test was .21. The nonacademic showed a lower relationship than the academic population.

The nonacademic showed a higher relationship between intelligence and the MTAI than the academic population. The value r = .50 was found for the nonacademic students. In the academic population the relationship was little more than chance. The value of r = .02.

The relationship of intelligence to the MMPI - "K" score was low. The highest relationship was found in the nonacademic population. The value of r = .13 (Table XIX).

In the total study population, percentile rank in high-school graduating class correlated high with general education grade-point average and total grade-point average. There was a higher relationship shown in general education by the academic population. The nonacademic showed a higher relationship in total grade-point average. The relationship between percentile rank and major grade-point average was lower for the total study

TABLE XIV

DISTRIBUTION OF STUDENTS' GRADE-POINT AVERAGE IN GENERAL EDUCATION AT THE END OF SEVEN SEMESTERS IN COLLEGE

College Grade-point Average	Total Study Population		Nonacademic Population		Academic Population	
	N	%	N	%	N	%
.87-1.17 (-2 S.D.)	1	1	1	2	0	--
1.18-1.48 (-1½ S.D.)	4	5	3	7	1	3
1.49-1.79 (-1 S.D.)	10	12	4	9	6	16
1.80-2.10 (-½ S.D.)	23	28	16	36	7	19
2.11-2.41	13	16	10	22	3	8
2.42-2.72 (+½ S.D.)	16	20	6	13	10	27
2.73-3.03 (+1 S.D.)	6	7	1	2	5	14
3.04-3.34 (+1½ S.D.)	5	6	3	7	2	5
3.35-3.65 (+2 S.D.)	1	1	0	--	1	3
3.66 and over	3	4	1	2	2	5
Number	82		45		37	
Mean	2.26		2.14		2.41	
S. D.	.60		.54		.63	
Range	1.15-4.00		1.15-4.00		1.42-4.00	

TABLE XV

DISTRIBUTION OF STUDENTS' GRADE-POINT AVERAGE IN MAJOR FIELD OF STUDY AT THE END OF SEVEN SEMESTERS IN COLLEGE

College Grade-point Average	Total Study Population		Nonacademic Population		Academic Population	
	N	%	N	%	N	%
1.11-1.39	1	1	0	--	1	3
1.40-1.68 (-2 S.D.)	2	2	0	--	2	5
1.69-1.97 (-1½ S.D.)	4	5	0	--	4	11
1.98-2.26 (-1 S.D.)	16	20	6	13	10	27
2.27-2.55 (-½ S.D.)	10	12	6	13	4	11
2.56-2.84	15	18	10	22	5	14
2.85-3.13 (+½ S.D.)	15	18	11	24	4	11
3.14-3.42 (+ S.D.)	7	8	6	13	1	3
3.43-3.71 (+1½ S.D.)	9	11	4	9	5	14
3.72-4.00 (+2 S.D.)	3	4	2	4	1	3
Number	82		45		37	
Mean	2.70		2.85		2.50	
S. D.	.57		.48		.67	
Range	1.19-3.91		2.06-3.91		1.19-3.77	

TABLE XVI

STABILITY OF DATA AS SHOWN BY THE 73-ITEM OBJECTIVE TEST

	N	M	S. D.
		Total Study Population	
First Testing	82	36. 83	7. 21
Second Testing	82	35. 84	6. 86
		r = . 65	
		Nonacademic Population	
First Testing	45	35. 07	6. 68
Second Testing	45	35. 22	6. 37
		r = . 84	
		Academic Population	
First Testing	37	38. 97	7. 26
Second Testing	37	36. 59	7. 37
		r = . 67	

TABLE XVII

STABILITY OF DATA AS SHOWN BY THE JUDGMENT TEST

	N	M	S. D.
		Total Study Population	
First Testing	82	-22. 68	38. 44
Second Testing	82	-27. 39	40. 19
		r = . 43	
		Nonacademic Population	
First Testing	45	-23. 69	36. 18
Second Testing	45	-27. 78	42. 18
		r = . 35	
		Academic Population	
First Testing	37	-22. 68	41. 02
Second Testing	37	-26. 92	37. 63
		r = . 52	

TABLE XVIII

STABILITY OF DATA AS SHOWN BY THE MTAI

	N	M	S. D.
		Total Study Population	
First Testing	82	22. 87	26. 42
Second Testing	82	31. 30	26. 63
		r = . 44	
		Nonacademic Population	
First Testing	45	15. 33	24. 66
Second Testing	45	30. 25	26. 49
		r = . 64	
		Academic Population	
First Testing	37	32. 03	25. 89
Second Testing	37	32. 57	26. 69
		r = . 23	

TABLE XIX

CORRELATION COEFFICIENTS FOR INTELLIGENCE WITH SEVERAL ACHIEVEMENT AND PSYCHOLOGICAL SCORES

Variables Correlated with Intelligence	Coefficients of Correlation		
	Total Study Population (82)	Nonacademic Population (45)	Academic Population (37)
Achievement	.64	.56	.66
Percentile Rank H. S.	.46	.29	.54
Total GPA	.41	.34	.56
General Education GPA	.60	.34	.71
Major Field GPA	.26	.44	.57
Judgment Test	.21	.17	.25
MTAI	.29	.50	-.02
MMPI-"K" Score	-.02	.17	.25

TABLE XX

CORRELATION COEFFICIENTS FOR PERCENTILE RANK H. S. WITH SEVERAL ACHIEVEMENT AND PSYCHOLOGICAL SCORES

Variables Correlated with Percentile Rank H. S.	Coefficients of Correlation		
	Total Study Population (82)	Nonacademic Population (45)	Academic Population (37)
Total GPA	.40	.43	.38
General Education GPA	.55	.51	.61
Major GPA	.28	.48	.42
Judgment Test	.07	.08	.05
MTAI	.31	.36	.14
MMPI-"K" Score	-.10	-.04	-.11

population than the academic and the nonacademic populations. This suggests the nonacademic and academic populations are quite different. Little relationship was shown between percentile rank and the Judgment Test. The value of r = .08 was found for the nonacademic. The academic r = .05.

The nonacademic students showed a higher correlation between percentile rank and the MTAI than the academic. The value of r = .36. The correlation for the academic was r = .14.

The relationship between percentile rank and MMPI - "K" scores was little better than chance. The academic had a higher correlation than the nonacademic. The value of r = .11 (Table XX).

There was a higher correlation between grade-point average (total, general education, and major field of study) and the MTAI for the nonacademic than the academic students (Table XXI). The nonacademic showed a high negative relationship between total grade-point average and MMPI - "K" score. The relationship between the MMPI - "K" score and grade-point average in general education and major field of study is little better than chance for both nonacademic and academic (Table XXI). The relationship between general education grade-point average and the Judgment Test for the academic students is high. The major grade-point average and the Judgment Test show some relationship for the academic students. This value of r = .29. All of the other relationships between grade-point average and the Judgment Test are little better than chance (Table XXII).

The relationship between the MTAI and the Judgment Test was higher for the nonacademic students. All of the variables correlated with the MTAI showed the higher relationship within the nonacademic population (Tables XIX, XX, XXI).

The academic students showed a higher correlation between the MMPI - "K" score and Judgment Test. The value of r = .48. The nonacademic population had a correlation of .23 (Table XXI).

In the nonacademic population the Judgment Test correlated .27 with the total achievement scores in educational psychology. The correlation for the academic population was .41 (Table XXII).

The findings of this investigation were compared with those of other investigations and with norms given by the manual.

Comparable results were found in a study by Draves (12) in an undergraduate educational psychology course at the University of Wisconsin in which 156 students constituted the study population.

Both Draves' (12) study and this used an attitudes scale to study student reactions to the course. This scale was developed by Draves in two large undergraduate educational psychology classes. Five items of the scale concerned attitudes toward the content of the course, and five items concerned attitudes toward the method of instruction in the classroom.

Students did not sign their names, but indicated their primary major. The findings are those based upon the responses of all students present the last class period of the semester prior to the final examination.

The items were scored so that a reaction very favorable to the course content or instructional methods employed was given four points, a very unfavorable reaction no points. Five of the items (numbers 1, 2, 6, 7, 8) were statements worded so as to be favorable to the course and instructional methods. A reply of "strongly agree" was scored four points, "strongly disagree" no points for the favorable items. Five items (numbers 3, 4, 5, 9, 10) were worded so as to be unfavorable statements about the course. A response of "strongly agree" was scored no points; "strongly disagree" four points for unfavorable items. The higher the score the more favorable the students' attitude toward the content of the course and the instructional methods used. The lower the score the more unfavorable the attitude. A score of 40 points was the highest possible on the total scale of ten items. Scores of 20 were the maximum for the five-item parts concerned separately with course content and instructional methods. Four points were the highest any one item could receive. Zero was the lowest score for each item or any group of items.

On the attitudes scale the mean score for University of Wisconsin education students was 20.2 (12:153). The mean score for WSCITP students was 26.8. The academic students had a higher mean score than the nonacademic students, 28.4 and 26.8 respectively.

The mean scores on the items concerning instructional methods were as follows: University of Wisconsin education students 8.7, WSCITP students 12.2, nonacademic 11.5, and academic 13.4.

On the items concerning course content, the mean scores for University of Wisconsin education students was 11.5, WSCITP students 14.6, nonacademic 14.4, and academic 15.0 (Table IX).

In comparing the mean reactions of the University of Wisconsin education students on the five items concerning instructional method and five items concerning course content, it was noted that in each instance the mean score on course content items was greater than the mean score on instructional methods. This indicates that the students of Draves' investigation and this study in general, were less satisfied with the methods by which the course material was presented than with the material itself.

At the end of the twelfth week of the semester the MMPI was administered to the students at WSCITP. Scores made on the MMPI were compared with norms (17). It was necessary to ad-

TABLE XXI

CORRELATION COEFFICIENTS FOR PSYCHOLOGICAL SCORES WITH GRADE-POINT AVERAGE

GPA Correlated with MTAI Scores	Total Study Population (82)	Nonacademic Population (45)	Academic Population (37)
	Correlation Coefficients for MTAI Score with GPA		
Total	.32	.45	.24
General Education	.36	.41	.19
Major Field	.19	.43	.28
	Correlation Coefficients for MMPI - "K" Score with GPA		
Total	-.29	-.48	-.08
General Education	-.09	-.08	-.06
Major Field	-.05	-.03	-.09

TABLE XXII

CORRELATION COEFFICIENTS FOR THE JUDGMENT TEST WITH ACHIEVEMENT AND PSYCHOLOGICAL SCORES

Variables Correlated with Judgment Test	Coefficients of Correlation		
	Total Study Population (82)	Nonacademic Population (45)	Academic Population (37)
Total GPA	.12	.16	.12
General Education GPA	.15	.10	.52
Major GPA	.17	.13	.29
Total Achievement	.33	.27	.41
MTAI Scores	.05	.37	-.29
MMPI-"K" Scores	.19	.23	.48

minister the whole test in order to get the "K" scores. The scoring was simple. The number of right responses on this part of the MMPI was the "K" score. The highest possible score was 30. The range of scores was 4 - 25 for the WSCITP students. Of the study population, the mean score was 15.79. The mean score of the nonacademic was 16.22. The mean score of the academic was 15.27 (Table VII). The published "K" score norms do not seem to include college students. Gowan (16), however, concluded that high "K" scores tend to distinguish individuals who are well adjusted, who tend to be emphatic and to make good counselors and teachers. He further stated that a high "K" score is a valid and widely reported test indicator of teaching potential.

The MTAI was administered at the end of the fifteenth week of school. It consisted of 150 items related to teacher-student relationships. The MTAI was designed to measure those attitudes of a teacher which predict how well he will get along with pupils in interpersonal relationships, and indirectly how well satisfied he will be with teaching as a vocation (8).

At the time the WSCITP students were enrolled in educational psychology they were similar to the beginning education juniors used in establishing the norms of the MTAI. For the study population of WSCITP the mean score was 22.87. The mean score of the nonacademic students was 15.33. The mean score of the academic students was 32.03. The standard deviations were as follows: study population 26.47, nonacademic 24.66, and academic 25.89 (Table VIII).

The mean score norms for the MTAI which were 44.1 for nonacademic students and 48.3 for academic students were for beginning education juniors which are well above those for WSCITP students. The standard deviation norms are nonacademic 27.1 and academic 29.2 which are also somewhat larger (Table VIII).

During the second semester of the 1959-60 academic year, when other data were secured, most of the WSCITP students were graduating education seniors. For this group the mean score was 31.30. The mean score for the nonacademic was 30.25, and the mean score for the academic was 32.57. These scores are still well below the junior year norms indicating that insofar as the test has validity WSCITP students have a someless acceptable attitude on teacher-pupil relationship. The standard deviations are as follows: study population 26.63, nonacademic 26.49, and academic 26.69 (Table VIII).

The mean MTAI score norms for graduating education seniors are, nonacademic 63.0, and academic 67.8. The standard deviation norms are nonacademic 33.3 and academic 24.3 (Table VIII).

To get an estimate of the meaning of the difference in attitude, as measured by scores on the MTAI, of the WSCITP nonacademic students and the norms of the MTAI the critical ratio was computed. If one assumes that the 45 WSCITP nonacademic students and the 185 students (8) used in establishing these norms are samples of a larger population, the significance of difference between them can be tested by the critical ratio. The critical ratio was 5.31. If the sampling assumptions mentioned above are granted, the difference was significant at the .1 percent level. We would expect to find this difference in sampling less than one time out of 1000 cases. Therefore, one might conclude that the WSCITP nonacademic students are different in attitude from the MTAI norms. The WSCITP nonacademic students showed a less desirable attitude toward teacher-student relationship than what is shown by the MTAI norms.

To get an estimate of the meaning of the difference in attitude, as measured by scores on the MTAI, of WSCITP academic students and the norms of the MTAI the critical ratio was computed. If one assumes that the 37 WSCITP academic students and the 237 students (8) used in establishing these norms are samples of a larger population, the significance of difference between them can be tested by the critical ratio. The critical ratio was 7.56. If the sampling assumptions mentioned above are granted, the difference was significant at the .1 percent level. We would expect to find this difference in sampling less than one time out of 1000 cases. Therefore, one might conclude that the WSCITP academic students are different in attitude from the MTAI norms. The WSCITP academic students showed a less desirable attitude toward teacher-student relationship.

During the tenth week of the semester, the verbal part of the CTMM was administered. The verbal part of the CTMM tested logical reasoning, numerical reasoning, and verbal concepts. The mean score of the study population as measured by the CTMM was 112.96. The mean of the nonacademic was 110.47 and the mean of the academic was 116.00. The standard deviations were as follows: study population 10.38, nonacademic 8.87, and academic 11.12 (Table XXIII).

Draves used the results of the American Council on Education Psychological Examination for College Freshmen. This test was administered to all entering freshmen at the University of Wisconsin. His findings were similar to those of this study. For his study population the mean score was 119. The standard deviation was 20. The mean score of the University of Wisconsin education students was similar to the mean score of the WSCITP academic students, i.e., the academic students at WSCITP are more similar to the University of Wisconsin education students than the nonacademic students at WSCITP (Table XXIII).

TABLE XXIII

COMPARISON OF WSCITP STUDENTS' MEAN CTMM SCORES WITH EDUCATION 75 STUDENTS' MEAN ACE SCORES

	Total Study Population	Nonacademic Population	Academic Population
	WSCITP Students' Mean Scores on CTMM		
Number	82	45	37
Mean	112.96	110.47	116.00
S. D.	10.38	8.87	11.12
	Education 75 Students' Mean ACE Scores		
Number	212	156	
Mean	119	119	
S. D.	20	20	

TABLE XXIV

COMPARISON OF MEAN SCORES OF WSCITP STUDENTS WITH MEAN SCORES OF EDUCATION 75 STUDENTS ON THE JUDGMENT TEST

	Total Study Population	Nonacademic Population	Academic Population
	WSCITP - Class Achievement-Judgment Test		
Number	82	45	37
Mean	-22.68	-23.69	-21.46
S. D.	38.44	36.18	41.02
	Education 75 - Class Achievement-Judgment Test		
Number	85		
Mean	-12.3		
S. D.	32.3		

To get an estimate of the difference in intelligence, as measured by scores on the CTMM, of WSCITP students and the intelligence, as measured by ACE scores, of the University of Wisconsin education students the critical ratio was computed. If one assumes that the 82 WSCITP students and the 156 University of Wisconsin students are samples of a larger population, and if one assumes that the CTMM and ACE test are similar, the significance of difference between them can be tested by the critical ratio. In making these assumptions it is important to recognize that a majority of the WSCITP students are enrolled in vocational education and a small minority of the University of Wisconsin education students are enrolled in vocational education. The critical ratio was 3.06. If the sampling assumptions mentioned above are granted, the difference was significant at the one percent level. We would expect to find this difference in sampling less than one time out of 100 cases. Therefore, one might conclude that the WSCITP students are different in intelligence from the University of Wisconsin education students. The University of Wisconsin students are more intelligent.

A Teacher Judgment Test was used in the educational psychology classes at WSCITP and by Draves (12:146).

For the study population of WSCITP the mean score was -22.68. The mean score of the nonacademic was -23.69. The mean score of the academic was -21.46. Standard deviations were as follows: study population 38.44, nonacademic 36.18, and academic 41.02 (Table XXIV).

For eighty-five of the study population of the University of Wisconsin students who had taken the Judgment Test, the mean score was -12.3. The standard deviation was 32.3 (Table XXIV). The mean score achieved on the Judgment Test was somewhat lower for WSCITP students. The two study groups had, however, about equal variability as expressed by standard deviations.

Another measure of achievement used to compare WSCITP students and University of Wisconsin education students was grade-point average.

For the WSCITP study population the mean grade-point average was 2.52. The mean grade-point average for the nonacademic was 2.49. The mean grade-point average for the academic was 2.55. The standard deviation for the study population was .48. The standard deviations for the nonacademic and academic were .44 and .55 respectively (Table XXV).

The mean grade-point average of University of Wisconsin education students was 2.79. The standard deviation was .43 (Table XXV).

Accordingly, the WSCITP students achieved less well than University of Wisconsin education students or the grading standard is different. The two study groups showed about equal variability as expressed by standard deviations.

Two sets of correlations were used to compare WSCITP students and University of Wisconsin education students.

One comparison was the correlation between intelligence and grade-point average. Draves' study showed intelligence, as measured by ACE scores, of University of Wisconsin education students correlated quite high with grade-point average r = .42 (12:127). Correlation between intelligence, as measured by CTMM scores, and grade-point average for WSCITP students was r = .41 which is quite similar.

The correlation between intelligence scores and scores on the Judgment Test for University of Wisconsin education students was r = .14 (12:127). The correlation between intelligence scores and scores on the Judgment Test for WSCITP students was r = .21 which is very similar.

The correlation between intelligence scores and the Judgment Test scores was lower for both study groups than the correlation between intelligence scores and grade-point average.

SECTION IV

Summary and Conclusions

1. Among the data-gathering devices employed in the study of WSCITP students was the MTAI. For the nonacademic students the mean score for WSCITP students on this instrument was 15.33 (norm 44.1). The academic mean score for WSCITP students on this instrument was 32.03 (norm 48.3). The attitudes of WSCITP students, as shown by scores on the MTAI, were accordingly below the norms for the MTAI. The MTAI was presumed to show how well teachers will get along with pupils in interpersonal relationships and indirectly how well satisfied they will be with teaching as a vocation.

2. When the MTAI was re-administered two years later these students were still below the norms. The mean score for the nonacademic students was then 30.25 and the mean score for the academic students was then 32.57.

3. The two above named sets of scores were correlated to secure information on the stability of these findings. The correlation for the two sets of MTAI test scores when the test was taken at the two different times was .44 for the study population, .64 for the nonacademic students, and .23 for the academic students indicating that the scores on the MTAI were moderately stable.

4. A comparison was also made of the scores of the WSCITP students and the norms for the MTAI. The critical ratio for the mean score of the WSCITP nonacademic students and the norms was 5.31. This difference between the observed

TABLE XXV

COMPARISON OF MEAN GRADE-POINT AVERAGE OF WSCITP STUDENTS WITH THE MEAN GRADE-POINT AVERAGE OF EDUCATION 75 STUDENTS

	Study Population	Nonacademic Population	Academic Population
	WSCITP Students' Mean Grade-Point Average		
Number	82	45	37
Mean	2.52	2.49	2.55
S. D.	.48	.44	.55
Range	1.76-3.91	1.81-3.91	1.76-3.68
	Education 75 Students' Mean Grade-Point Average		
Number	212	156	
Mean	2.81	2.79	
S. D.	.42	.43	
Range	1.48-3.91	2.11-3.76	

mean score and the norm was significant at the .1 percent level. The critical ratio for the mean score of the WSCITP academic students and the norms was 7.56. This was significant at the .1 percent level. In both the nonacademic and academic groups the mean scores of the WSCITP students were below the norms.

5. A further study was made of these students through the use of an especially constructed attitudes inventory which aimed to secure information relative to the attitude of students toward the content of educational psychology courses and the instructional methods of presenting the material. The attitudes of these students, as shown by scores on the 10-item attitudes scale developed by Draves in two large educational psychology classes at the University of Wisconsin (12), were less favorable toward the method by which the course material was presented than with the material itself. The mean attitudes score toward the method of instruction was 12.18. The mean attitudes score toward the course material was 14.58.

6. Draves found the same for the attitudes of University of Wisconsin education students toward method and course content as shown by the scores of WSCITP students. The mean attitudes score toward course material was 8.7. The mean attitudes score toward course content was 10.9. The attitudes scores of University of Wisconsin students studied were, however, in both cases lower than the attitudes scores of WSCITP students studied.

7. The MMPI was administered to secure information relative to certain personality characteristics. Only the "K" scores were used. For nonacademic students the mean "K" score on the MMPI was 16.22. The mean "K" score for academic students was 15.27. The "K" score was presumed to measure teaching potential.

8. The verbal portion of the CTMM was used to secure information on certain intellectual characteristics. The mean score of WSCITP students was 112.96. The mean score of the academic students was 116. A lower mean score of 110.47 was achieved by the nonacademic students. The verbal portion of the CTMM was presumed to measure logical reasoning, numerical reasoning, and verbal concepts.

9. The mean score of the University of Wisconsin education students, as measured by ACE test scores which is a different test, was 119. It cannot be assumed that the ACE and CTMM measured similar abilities except in a very general sense.

10. A comparison was also made of the CTMM scores of the WSCITP students and the ACE scores for the University of Wisconsin Students. The critical ratio for the mean score of the WSCITP students and the mean score of the University of Wisconsin students was 3.06. This difference was significant at the one percent level. The mean score of the WSCITP students was below the mean score of University of Wisconsin students. In interpreting this ratio it should be noted over and above the fact that the two tests were different, that the WSCITP group had a much larger percentage (96%) of vocational education students in the nonacademic group.

11. As a measure of the achievement characteristics of WSCITP students, rank in high-school graduating class was studied. The mean percentile rank of the nonacademic students as shown by the student's position in high-school graduating class was 51.27. A higher mean percentile rank of 64.16 was shown for the academic students.

12. A series of especially constructed educational psychology achievement tests was used to secure information on achievement in educational psychology. The mean achievement score for the nonacademic students was 136.31. The mean score of the academic students was 149.84. This series of tests was presumed to measure student knowledge of basic facts and concepts in educational psychology.

13. The Judgment Test was used as a measure of professional judgment. The mean score of the nonacademic students was -23.69. The mean score of the academic students was -21.68. Draves found a mean score of -12.3 achieved by University of Wisconsin education students on this same test.

14. The Judgment Test was readministered two years later to the WSCITP students. The mean score for the nonacademic students was then -27.78 and the mean score for the academic students was then -26.92.

15. The two sets of Judgment Test scores, achieved by WSCITP students, were correlated to secure information on the stability of these findings. The correlation for the two sets of Judgment Test scores when the test was taken at two different times was .43 for the study population, .35 for the nonacademic students, and .52 for the academic students, indicating that the scores on the Judgment Test were moderately stable.

16. The 73-item objective test was used to test the students' knowledge of basic facts and concepts in educational psychology. The mean score of the nonacademic students was 35.07 and the mean score of the academic students was 38.97.

17. When the 73-item objective test was readministered two years later the mean scores dropped slightly. The mean score for the nonacademic students was then 35.22 and the mean score for the academic students was then 36.59.

18. The two above named sets of scores were correlated to secure information on the stability of these findings. The correlation for the two sets of test scores when the test was taken at two different times was .65 for the study population, .84 for the nonacademic students, and .67 for the

academic students, indicating that the scores on the 73-item objective test were stable.

19. Grade-point average was computed as a measure of achievement. The mean grade-point average for the nonacademic students was 2.49 and the mean grade-point average for the academic students was 2.55. Draves found a higher mean grade-point average of 2.79 was achieved by University of Wisconsin education students.

20. In general education courses the mean grade-point average of the WSCITP nonacademic students was 2.14 and the mean grade-point average for academic students was 2.41.

21. In major field of study courses the mean grade-point average of the nonacademic students was 2.85 and the mean grade-point average of the academic students was 2.50.

22. Correlations were computed to determine patterns of relationship between the several measures. Substantial positive correlations were found among measures as follows:

a. Intelligence and achievement in educational psychology .64, intelligence and percentile rank .46, intelligence and total grade-point average .41, and intelligence and general education grade-point average .61.
b. Percentile rank and total grade-point average .40, and percentile rank and general education grade-point average .55.
c. Total grade-point average and MTAI .32, and general education grade-point average and MTAI .36.
d. Judgment Test and achievement in educational psychology .33.

Conclusions

Students in this study showed a somewhat undesirable attitude in teacher-pupil relationship. This was evidenced by low mean scores on the MTAI. This undesirable attitude may be related to the home and family background. A majority of these students lived on farms. These homes may be more autocratic than city homes. Possibly this influenced the students' attitudes. It may also be related to the attitude of the faculty of WSCITP. In agricultural education and industrial arts classes the atmosphere may be more conducive to harmonious teacher-pupil relationship.

The students at WSCITP have a less favorable attitude toward the method of instruction than toward the course content in educational psychology.

The WSCITP students achieved a higher mean score on the total attitudes scale than did the University of Wisconsin education students.

The intellectual level of the WSCITP nonacademic students was lower than the intellectual level of the academic students. As was pointed out in the design, almost all of the nonacademic students at WSCITP were enrolled in vocational education. The intellectual level of the University of Wisconsin was above the intellectual level of both groups of WSCITP students. The difference in the intellectual level between the WSCITP nonacademic and academic students may be related to the home and family background. The difference between the intellectual level of the WSCITP students and the University of Wisconsin education students may be related to the selective nature of the University of Wisconsin. The WSCITP students are largely from Southwestern Wisconsin and the rural areas of the state. There are no large cities in Southwestern Wisconsin. The University of Wisconsin attracts students from all the states and many foreign countries.

The University of Wisconsin education students showed greater achievement than did the WSCITP students. The higher achievement of the University of Wisconsin education students may be related, in part, to the higher entrance requirements of the School of Education at the University.

The less than acceptable attitude in teacher-pupil relationship of these Wisconsin State College students suggests a need for further study to determine the reasons for this lack. This may produce something of value in the planning of the program of teacher education with a view towards improving this less than acceptable attitude in teacher-pupil relationship.

There seems to be a need for an evaluative study of the teacher education program offered at this Wisconsin State College in view of the intelligence level of its students. This may lead also to a new look at the entrance requirements and to a follow-up of graduates to determine if they are successful.

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A STUDY OF THE INFLUENCE OF VARIABLES ON GROUP DATA*

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The Situation

THE ACHIEVEMENT of increasing control over the variables with which one is concerned is a major goal of science. This goal has been achieved with satisfactory degrees of certainty in the exact sciences. The activities of researchers in education and all the other life sciences have not achieved like powers of prediction and control. One reason frequently given for their less satisfactory results is that quantities in the life sciences are resultants of so many hundreds of variables that it is extremely difficult to determine which factor is the cause of a given observed effect. The life sciences, therefore, have based their efforts on studying trends and have done so by borrowing statistical theory and methods from fields which have found them satisfactory: finance, logistics, manufacturing, etc.

It is the contention of this study that even though such logic and methods are satisfactory for the purposes for which they were designed, they have not lead to that degree of control and prediction in the life sciences which results in the discovery of law. It is a further contention of this study that degrees of prediction and control comparable to those in the exact sciences can be achieved in the life sciences if statistical methods adjusted to life conditions are utilized with data that is reasonably complete and accurate.

Statement of the Problem and Data Used

The purpose of this study, therefore, is to determine whether or not the utilization of a single variable technique, coupled with appropriate individual statistical procedures, will lead to more effective prediction and control than do the more conventional programs of analysis.

A body of group data has been collected which appears reasonably accurate and sufficiently complete to merit the initiation of a scientific study of the effect of single variable analysis upon it. These data are the measurements of nineteen physical characteristics of boys and girls between the ages of four and fifteen. These children are from sixteen selected states and the District of Columbia. In addition to the physical data, other pertinent information has been recorded which make them desirable for the proposed study.

The data were collected from 1937-39 by the Department of Agriculture through its Textiles and Clothing Division in the Bureau of Home Economics. Conclusions from the results of the project were to be used by persons and firms interested in pattern and garment construction. They were reported in Miscellaneous Bulletin 366 of the Department of Agriculture, entitled Body Measurements of American Boys and Girls.

For the purposes of the Bulletin, the data were analyzed by acceptable statistical techniques, and these results are also reported by the Department in the Bulletin. These were used to devise a proposed system of sizes (pp. 41-49). It is, therefore, presumed that the sizes of children's clothing manufactured since the publication of the Bulletin have been based upon these data.

All nineteen physical measures have been summarized by age, state of residence, community size, birthplace of parents, and socio-economic status of the father. They are reported separately for girls and boys.

Validity and Conclusion

The undertaking was carefully planned, efficiently carried out, and meticulously checked for validity of results. The measurements were devised by a staff of competent anthropomometrists and the statistical analyses were made under the

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** Consultant, Dr. Stuart A. Courtis, Professor Emeritus of Education, University of Michigan.

direction of competent government statisticians. The results reported included: means, standard deviations, tests of significance, partial and multiple correlations, bivariate distributions with test of normality, coefficients of variation, coefficients of correlation and regressions of weight on stature. The competence of the measurers and the accuracy of the measurements were determined by a special investigation.

The study is an excellent example of a survey of trends. The Bulletin[1], however, did not deal with the data on a single variable basis. Surely such data, collected by an agency of the United States Government to be used in commercial ventures, should provide an excellent base from which to initiate a comparative single variable study.

Purpose

The purpose of the present investigation is to be achieved by studying the effect of each of the variables, and the interrelationships among several variables, upon bodily dimensions. If such effects can be demonstrated in unambiguous terms there would appear to be little doubt but that the single variable methods could be used with confidence in other situations usually considered less objective.

A Preliminary Investigation

Even though the data seem ideally suited to a single variable study, it appeared prudent first to undertake a "pilot study" to determine first-hand the likelihood of success of a study of large groups of individuals representing many states and different backgrounds. This pilot study is, therefore planned as a test of the value of both single variable method and the usefulness of the data, as well as a means for devising the most efficient plan for carrying out the larger study should it prove to be warranted.

The pilot study will attempt to apply both the law of the single variable and personalized statistics to a limited section of the total data and to contrast the results with those obtained by mass statistics. Both objectives will be described in some detail.

The Law of the Single Variable

The law of the single variable was first formulated by May Ayers Burgess in 1921. Monroe and Englehart stated in 1936 (20), "It seems reasonable that recognition of the law of the single variable might lead to significant refinements in measuring human abilities and traits." (p. 181)

The Law of the Single Variable as used in this study is: A specific effect may be ascribed with certainty to a given factor as cause only when the effects of all other factors have been eliminated, or their effects allowed for in terms of their previously determined laws of action.

The major flaw seen in the data in the bulletin issued by the Department of Agriculture is that the application of mass statistics to the data appear to have concealed the effect of many of the variables. Fisher states: "Grouping in effect replaces the actual data by fictitious data placed arbitrarily at the central values of the groups, evidently a very coarse grouping might be very misleading." (16:52).

This study will try to remedy that defect by scrupulous adherance to the law of the single variable. The effect of each variable will be analyzed as independently of others as possible when dealing with the data. In conducting the investigation of this project every attempt will be made to proceed on the following operational principles:

1. Accept the single variable principle as a basis of analysis insofar as possible.
2. Investigate all unresolved data for additional factors.
3. When more than one means of description is available, choose the one which describes a specific observable phenomenon rather than one based upon logical deductions from observation.
4. When two means of description seem equally specific, choose the one which appears most simple.
5. Use mass methods of analysis only after as many variables as possible have been accounted for.

Philosophy of the Investigation

Acceptance of principle 1 as a basis for operation means in this study that when one attempts to determine the relationship between one variable quantity, A, and a second variable quantity, B, the single variable principle having been applied perfectly to each, the relation of A to B in the pairs of measurements of the two factors will be found to be identical in value in every case.

The single variable principle is thus both a guide to absolute truth under the given conditions and an indicator of the degree to which it is being achieved. When perfect accuracy is not achieved, it is an indication that further variables must be removed from the quantities before they will be

1. Throughout this study, "the Bulletin" refers exclusively to Miscellaneous Bulletin No. 366, Body Measurements of American Boys and Girls for Garment and Pattern Construction, Textiles and Clothing Division, Bureau of Home Economics (Washington, D.C.: U.S. Dept. of Agriculture, July 1941).

suitable for such comparison.

When the application of principles 2, 3, 4, do not result in perfect consistency in results, principle 5 will be applied, but not before that point. The investigators are aware of the fact that a perfect single variable comparison is not humanly possible to achieve. Their aim, however, is to reach as close an approximation to absolute truth as is possible

Availability and Securing of Data

Numerous texts and articles on "Human Development" suggest that effects attributable to socio-economic status are measurable (2, 15, 17, 18). Olson (20:255) goes as far as to state that one investigating differences in achievement would be naive if he did not consider socio-economic status as a cause for such differences. Since most educational studies do not take socio-economic status into account, the desire to study its effects grew.

The data in the Bulletin seemed admirably suited to such a study. Several letters were written and calls made to see if the data were available. Finally, a visit was made to the Department of Agriculture to make arrangements for use of the data for this investigation. The inquiries were referred to Dr. Batchelder, Director of the Clothing and Housing Division of the Agriculture Research Service who, in consultation with others in authority, generously gave permission to have the Service Bureau Corporation duplicate for us the IBM punch cards upon which the data were recorded.

The cards of all the children measured were ordered. The cards for the girls, however, were in use and copies could not be obtained. The Bulletin indicated that the data on 76,744 boys had been recorded: 61,653 of native parentage and 15,091 of foreign or mixed parentage. The study that the Department made to check the accuracy of their data resulted in the rejection of all cases demonstrably inaccurate or incomplete (Bulletin, p. 22). These operations reduced the number of records from the total of 147,088 to approximately 133,000. Eventually, the cards of 69,393 boys were received from the Service Bureau Corporation.

Defects

The code sheet accompanying the cards indicated that all data described in the Bulletin were on the cards received. When the cards were run at the University of Delaware all the items checked were actually on the cards. Two items, however, proved to be general rather than specific as expected. These related to birthplace of the parents and to socio-economic status and will be discussed specifically when dealing with these variables.

In attempting to determine whether the specific information as to birth of parents and socio-economic status could be obtained, several more calls and another visit to Washington were made. It was found that only one of the three original working schedules were stored in a warehouse in Arlington, Virginia. Their information from the other two had been generalized on Work Sheet I and the original sheets themselves destroyed. Consequently, the study as planned could not be carried out as completely as expected.

Children Measured

The states and the number of children measured in each as given on page 2 of the Bulletin were:

1.	Alabama	9223
2.	California	5532
3.	Colorado	9258
4.	District of Columbia	5258
5.	Illinois	14597
6.	Iowa	8644
7.	Kansas	9425
8.	Maryland	6704
9.	Michigan	12210
10.	Minnesota	13235
11.	Nebraska	7354
12.	Ohio	12527
13.	Pennsylvania	8663
14.	Tennessee	6257
15.	Texas	7959
16.	Utah	9407
17.	Virginia	876
	Total	147088

California and Tennessee Selected for Pilot Study

In view of the great differences in climatic and industrial conditions in the states, it was decided to limit the pilot study to two states only. California and Tennessee were selected.

The reason for this selection was that the bodily dimensions of height and weight in them was found to differ most widely (Bulletin, Table 63, p. 123).

Specific Procedures

Cards Sorted Into Packs

Before any tabulations were made, the 70,000 cards for boys were sorted into packs by variables until groups were secured, each of which in itself was homogeneous with respect to all variables except socio-economic status. The following are the variables by which the cards were sorted:

First variable—Sex. The cards obtained were all of one sex, male. Number of cards, 69,393. The exact number of the cards were not counted in the first three divisions. The number given

here was computed from the Bulletin and is reasonably correct. These numbers are presented only as illustrative of the method and its results.

Second variable—State of residence. The cards were next sorted by states of birth of the children. California and Tennessee were retained as explained above. The two packs of cards so obtained numbered 10,569: California, 5002; Tennessee, 5567.

Third variable—Birthplace of parents. A further selection was made from each of these two packs. The birthplace of both the father and mother were recorded by country rather than by state as were the children, i.e., all parents born in the United States were given the code number 1. The cards of those boys whose parents were born in the United States were selected. This sorting reduced the number in the two packs to 7982 cards: California, 3778; Tennessee 4204.

Fourth variable—Community size. The cards of all the boys who were living in either a rural-farm or a rural-non-farm community were next eliminated by sorting from each pack and reserved. The two packs were now homogeneous in that all came from a community of 2500 or larger. Total select cases 4065: California 1730; Tennessee 2335. These quantities as well as subsequent ones are exact figures from the IBM counter.

Fifth variable—Socio-economic status. Although the Bulletin indicated that socio-economic status was divided into at least five categories, the cards were actually grouped by the Department of Agriculture into only three. This was not evident from reading either the sample working schedule published in the Bulletin or the code sheet from which the cards were punched. Professional, semi-professional and skilled workers were grouped under socio-economic group A. Semi-skilled and unskilled laborers were grouped under socio-economic group B. Any father from either category who had received relief was to be listed as socio-economic group C. The Department of Agriculture did not use the data listed under socio-economic group C. Therefore, our records contain only those from A and B.

An effort was made to obtain the specific job classification for each parent. This was recorded originally on working schedule II and it, like other data on that schedule, had been condensed and transferred to working schedule I and then destroyed.

No cards were eliminated by sorting at this time so that the total number remaining is still 4065 but they are now in four packs: California A, 890, California B, 840; Tennessee A, 1212, Tennessee B, 1123. Each of these packs is homogeneous in itself with respect to each of the previous variables and socio-economic status.

Sixth variable—Age. The decision was made to reduce the range of the age groups as much as possible. The Bulletin grouped children by years. That is, a child who was fifteen days over fifty-nine months of age was listed as being five years old as were all children who were no older than fourteen days more than seventy-one months of age. The cards in this present study were sorted into half-year groups, the basic age plus or minus three months. That is, a five-year-old would be one who was not younger than fifty-eight months nor older than sixty-three months of age. Those as old as sixty-four but no more than sixty-nine months were placed in the five-and-a-half year group. This sorting produced ninety-two packs of cards each representing a half-year age group. These were twenty-three groups from four years to fifteen years in each of the two socio-economic groups for each of the two states.

The heights and weights of each individual of the ninety-two packs were printed.

Illustration of Packs

By the way of illustration, the individual measurements from one of the ninety-two packs are shown in Table I. These data are for the five-year-old boys from a Tennessee city, both of whose parents were born in this country and whose father is categorized as socio-economic group B. There are twenty-four children in this group. The names of the children are represented by a code number from 1-24 (first column). Columns 2, 4, and 6 show the measurements of age, height, and weight arranged in order of magnitude. Since the measurements are in the order of magnitude, columns 3 and 5 identify the individual. The boy who is youngest in age (no. 1) is not the shortest in height. There are thirteen boys shorter than he. In order to trace individual relationships between age, height and weight, the code identifying the individuals is placed in each column. Boy 15 is the shortest in height while Boy 6 is the lightest in weight.

Individual variations similar to these occur in all ninety-two packs.

The table is arranged to show how the mid-scores, which are used in making comparisons with the means in the Bulletin, are obtained. Means and sigmas are also found. Mid-scores are a specific observable fact whereas means are logical deductions from many observable facts (operating principle 3, p. 194).

Contrast Between Conventional and Single Variable Methods

The mean derived from the unsorted data would reveal only the trend of the measurements. In this table (Table I) where every individual's personal scores are shown, it may seem confusing to attempt to draw any conclusions from the data, but when it is remembered that the simplicity of the means which are derived from these data sacri-

FIGURE A

DIAGRAM OF THE OPERATION OF THE PROCESS OF SELECTING AND GROUPING BY VARIABLES

Variables:	Sex	State	Birth Place of Parents	Community Size	Socio-Economic Status	Age
Process:	Purchase Boys Cards	Select California and Tennessee from total	Select only American born	Select only Urban	Group by A and B	Group by half year
Number of Packs:	Total cards received 1 pack	2 packs	2 packs	2 packs	4 packs	92 packs
Sub totals remaining in each pack	California	5002	3798	1730	A 890 B 840	
	Tennessee	5567	4204	2335	A 1212 B 1123	
Totals	69,893	10,569	7,982	4,065	4,065	4,065

These 92 packs of cards, 23 from each socio-economic group from each state are each homogeneous with respect to the six variables. Each contains cards which represent the height and weight of: (1) Boys: (2) from one state; (3) whose parents are American born; (4) who live in a city of 2500 or more; (5) whose fathers are in the same age plus or minus three months.

TABLE I

ILLUSTRATIONS OF THE RECORDS OF MEASUREMENT OF INDIVIDUAL BOYS IN ONE OF THE 92 HOMOGENEOUS GROUPS, TENNESSEE, SOCIO-ECONOMIC STATUS, GROUP B, AGE 5.0 YEARS

	Individual Code Number	Age in Months	Code Number	Height in Centimeters	Code Number	Weight in Pounds
	1	58	15	30	6	99
	2	58	6	32	15	99
	3	58	10	33	23	100
	4	58	21	33	1	100
	5	58	22	34	16	102
	6	59	19	35	17	102
	7	59	7	35	2	102
	8	59	11	36	12	103
	9	59	16	36	10	103
	10	60	8	37	21	103
	11	60	23	37	7	104
	12	60	12	38	22	105
	13	60	17	39	20	107
	14	60	1	39	3	107
	15	61	2	40	11	108
	16	61	13	41	19	108
	17	61	20	41	18	108
	18	61	3	42	4	110
	19	62	18	41	13	111
	20	62	4	42	8	112
	21	63	14	45	5	114
	22	63	9	45	24	114
	23	63	5	45	14	115
	24	63	24	46	9	115
Mid-Value	13	60	13	39	13	107
Range	24	6	24	17	24	17
Coefficient of Dispersion	185%	10%	185%	44%	185%	16%
Mean		60.25		38.38		106.29
Standard Deviation		1.71		4.38		5.12
Coefficient of Variation		**2.8**		**11.4**		**4.8**

fice the identification of the variations it is desired to study, such detail is necessary. So far as means and mid-scores are concerned, to the degree that the distribution of the scores is symmetrical, the means and the mid-scores are identical. But to the degree that the distributions are irregular, the trend revealed by the means conceals the distorting factors. This fact will be made evident many times in the discussion which follows.

The Statistics Used in This Study

Also in accordance with Principle 3, page 194 of this report, range (high - low + one) will be used instead of standard deviation as the measure of dispersion. In addition, a new measure, coefficient of dispersion (range divided by mid-score) is used in place of coefficient of variation. The values for these three measures for this group are given at the bottom of Table I.

The reader should note that it is the conclusions from these measures which will be compared with the conclusions from the Bulletin. For instance, on page 92 of the Bulletin, the heights of 296 ten-year-old boys is given as 140.80 centimeters, but these 296 boys are of all types so that the mean conceals the effects of the differences in place of residence, parentage, community size and socio-economic status. The standard deviation in the Bulletin is 7.13 centimeters, but in Table I it is 4.38 centimeters. In the present study the mid-score for boys of ten years of age from California of American-born parents who live in an urban area and are in socio-economic group A is 139 centimeters. While the mid-score from the single variable group differs only 1.8 centimeters from the mean of the 296 boys, the range differs from the standard deviation by almost 31 centimeters (7.13—38.0). From the point of view of this study the extent of the dispersions in the groups are concealed by the standard deviations, but this very dispersion may be the effect of socio-economic status. Whether it is or not will be revealed by comparisons with those of all the groups homogeneous with this one in all ways except socio-economic status. These comparisons will be made using the coefficients of dispersion (range mid-score). It should be noted in Table I that the coefficients of dispersion vary markedly: 10, 43, and 16. Such differences indicate that variables other than those so far recognized are operating.

A Single Variable Relationship

To illustrate a single variable determination of relationship the coefficients of dispersion for age were computed (Table II). The amount of dispersion is fixed at six months by definition of the age group, while the mid-score for age increases from group to group. Consequently, the coefficient of dispersion for age steadily declines in a systematic manner as shown in Figure B (see top of next page). The reason why the coefficient of dispersion for ages 4.0 and 15.0 differ from the pattern is that these groups are not complete. There were no measures of children recorded by the Department of Agriculture who were younger than 48 months. This age group therefore had a range of only four months. The 15.0 group consisted of only two children with a range of only three months. Figure B is, therefore, not only an excellent example of the type of consistent pattern which indicates the achievement of a single variable relationship, but it is also an excellent example of a method of identification of causes of deviation from a single variable relationship.

Appearance of Data After Sorting and Comparison

The mid-scores for each age from each of the two socio-economic groups (A and B) from both California and Tennessee were found and recorded (Table III).

It was our original hypothesis that the data at this point would permit a single variable comparison of the effect of socio-economic status on both height and weight in both states. Inspection of these data indicate that the trends in heights tend to favor the California boys in socio-economic group A. These comparisons can be most clearly seen in examining the ratios of A to B (Table IV). The mid-ratio for height in California is $1.01 \pm .045$ and for height in Tennessee is $1.02 \pm .092$. The mid-ratio for weight in California is 1.02 and for Tennessee is $1.06 \pm .176$.

Since, however, this is a single variable study the acceptance of trends is not permissable until the search for all other possible variables has been exhausted. The differences in height on the average are less than two percent. Then, too, there are reversals. The weights appear to differ by a greater margin but this is less than six percent. These relationships are far from achieving the required consistency of Figure B. This is proof that other variables are functioning.

Coefficient of Dispersion

It must be remembered that the range is used as a measure of dispersion to insure that variations would be revealed. Standard deviation or variance are considered better measures of dispersion by those who wish to eliminate the effect of variation due to non-typical cases. However, the coefficients of dispersion are used purposely in this study to determine whether or not more variables are operating than those originally perceived. Please note that range is defined as H - L + 1 (Table V). In mass statistics the conven-

TABLE II

COEFFICIENTS OF DISPERSION IN A SINGLE VARIABLE RELATIONSHIP

Mid score	Range	Coefficient of Dispersion
4.0	4	.083
4.5	6	.111
5.0	6	.100
5.5	6	.091
6.0	6	.083
6.5	6	.077
7.0	6	.071
7.5	6	.067
8.0	6	.063
8.5	6	.059
9.0	6	.056
9.5	6	.053
10.0	6	.050
10.5	6	.048
11.0	6	.045
11.5	6	.043
12.0	6	.042
12.5	6	.040
13.0	6	.038
13.5	6	.037
14.0	6	.036
14.5	6	.034
15.0	3	.020

TABLE III

MID HEIGHTS AND MID WEIGHTS OF BOYS BY AGE, STATE, SOCIO-ECONOMIC STATUS A AND B

AGE	HEIGHT				WEIGHT			
	CAL.		TENN.		CAL.		TENN.	
	A	B	A	B	A	B	A	B
4.0	106	104	103	100	42	38	37	34
4.5	106	107	107	102	38	40	38	37
5.0	113	106	107	106	45	40	39	39
5.5	112	111	113	109	42	44	44	41
6.0	117	116	114	114	49	48	42	44
6.5	120	119	119	117	50	51	48	46
7.0	122	121	119	118	53	51	50	48
7.5	125	125	125	123	56	56	52	50
8.0	128	127	126	126	60	56	55	52
8.5	131	132	130	127	60	63	59	55
9.0	134	135	133	130	67	65	60	56
9.5	137	136	134	132	69	66	64	59
10.0	139	137	138	135	74	69	66	63
10.5	143	142	139	135	79	75	70	65
11.0	145	141	142	140	81	74	71	68
11.5	147	148	142	142	81	84	72	72
12.0	148	148	146	145	88	85	76	75
12.5	152	150	149	147	94	90	80	81
13.0	155	153	151	149	92	93	87	80
13.5	156	157	154	152	97	106	94	88
14.0	162	161	161	155	108	108	105	89
14.5	162	165	165	157	119	117	110	97
15.0	162	166	163	170	120	121	110	122

TABLE IV

RATIOS MID-MEASURES OF SOCIO-ECONOMIC GROUP A TO B, C/T

	California		Tennessee		
age	Ht.	Wt.	Ht.	Wt.	Age
4.0	1.019	1.1053	1.0300	1.0882	4.0
4.5	.9906	.9500	1.0490	1.0270	4.5
5.0	1.0660	1.1250	1.0094	1.0000	5.0
5.5	1.0090	.9545	1.0367	1.0732	5.5
6.0	1.0086	1.0208	1.0000	.9545	6.0
6.5	1.0084	.9804	1.0171	1.0435	6.5
7.0	1.0083	1.0392	1.0000	1.0417	7.0
7.5	1.0000	1.0000	1.0163	1.0400	7.5
8.0	1.0078	1.0714	1.0000	1.0577	8.0
8.5	.9924	.9524	1.0236	1.0727	8.5
9.0	.9926	1.0308	1.0230	1.0714	9.0
9.5	1.0074	1.0454	1.0152	1.0847	9.5
10.0	1.0146	1.0725	1.0222	1.0476	10.0
10.5	1.0070	1.0533	1.0296	1.0769	10.5
11.0	1.0284	1.0946	1.0143	1.0441	11.0
11.5	.9932	.9643	1.0000	1.0000	11.5
12.0	1.0000	1.0353	1.0069	1.0133	12.0
12.5	1.0133	1.0444	1.0136	.9877	12.5
13.0	1.0131	.9892	1.0134	1.0875	13.0
13.5	.9936	.9151	1.0132	1.0682	13.5
14.0	1.0062	1.0000	1.0387	1.1798	14.0
14.5	.9818	1.0171	1.0510	1.1340	14.5
15.0	.9759	.9917	.9588	.9016	15.0
Mid Ratio	1.01 ±.045	1.02 ± .103	1.02 ±.092	1.06 ±.176	

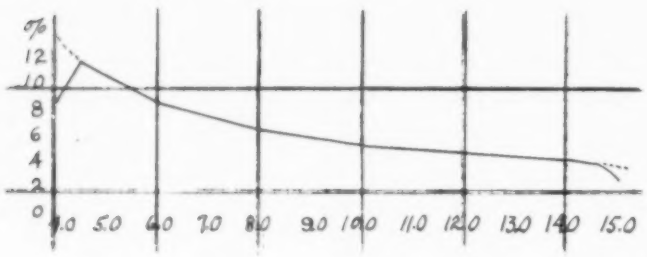
TABLE V

RANGE OF SOCIO-ECONOMIC GROUPS A AND B IN HEIGHT AND WEIGHT OF BOYS

	HEIGHT				WEIGHT			
AGE	CAL.		TENN.		CAL.		TENN.	
	A	B	A	B	A	B	A	B
4.0	13	18	8	14	16	17	5	15
4.5	13	13	15	15	19	13	20	14
5.0	21	18	14	16	24	14	13	20
5.5	19	21	26	31	30	24	28	24
6.0	16	18	11	23	18	24	17	31
6.5	39	27	22	24	26	20	15	23
7.0	29	27	21	29	39	33	28	24
7.5	19	19	23	36	20	26	33	29
8.0	23	21	31	26	47	31	51	53
8.5	20	27	28	30	31	52	43	46
9.0	26	29	29	40	36	37	42	47
9.5	28	22	24	24	40	39	42	57
10.0	38	27	31	38	52	48	62	73
10.5	39	25	31	31	70	61	38	55
11.0	26	21	30	31	67	39	73	60
11.5	27	30	32	30	56	86	53	45
12.0	30	34	35	36	70	45	79	60
12.5	31	30	40	32	67	60	67	55
13.0	30	35	38	37	100	59	73	99
13.5	33	34	34	40	69	95	86	65
14.0	43	38	46	38	98	83	88	77
14.5	29	35	30	36	88	86	70	51
15.0	22	15	30	9	63	72	73	13

FIGURE B

COEFFICIENTS OF DISPERSION IN A SINGLE VARIABLE RELATIONSHIP



tional index of dispersion is the coefficient of variation which is the standard deviation divided by the mean. In this study, range divided by mid-measurement is used (Table VI). This measure has been termed coefficient of dispersion to differentiate it from coefficient of variation. The analysis of trends by group comparison proves that even after careful sorting into ninety-two homogeneous groups in terms of the foregoing six variables, the comparison of trends from each of the ninety-two groups confirms very exactly the data published in the Bulletin (Table 66, p. 129). Up to this point, therefore, neither method can be considered superior except that the single variable method directs attention to factors that otherwise are likely to go unnoticed.

Size of Group as a Heretofore Unrecognized Variable

One variable that might be effecting the data is size of the groups. It was noted when sorting the cards that there were wide variations in the number of cases in each of the ninety-two groups (Table VII). It appears obvious that the size of the group must effect the dispersion of the distribution once a question about relation of size to dispersion is raised when the distributions are drawn.

By way of illustration, a sample of 100 cases (Figure C) is randomly selected from a distribution of 150 cases (Distribution A). Distribution B would be expected to have the same central tendency and dispersion as did A and as would the remaining cases making up Distribution C (law of large numbers). These distributions are obviously different in one characteristic: The ratio between the altitude and the base line has been altered This relationship can be maintained only if the dispersion and, therefore, the dispersion index is reduced. The degree to which the shape of the distribution effects its characteristics should be studied.

Supplementary Investigation

To control variations in size, a sample of forty-five individuals was taken from the Harvard Growth Data. Since these data are longitudinal in character, the size of the group at each age remains constant at forty-five. This sample is homogeneous with the A socio-economic group in our study: all boys, all from one state, all from one city, all from Northern European parentage, and with the same socio-economic status and age except that age groups are by years instead of by half-years (Table VIII). Note that coefficients of dispersion for the various ages are considerably less variable than those of the previous table because of the consistency in the size of groups. There is still considerable variation, however. In terms of our single variable theory this means that still another variable previously unrecognized is operating.

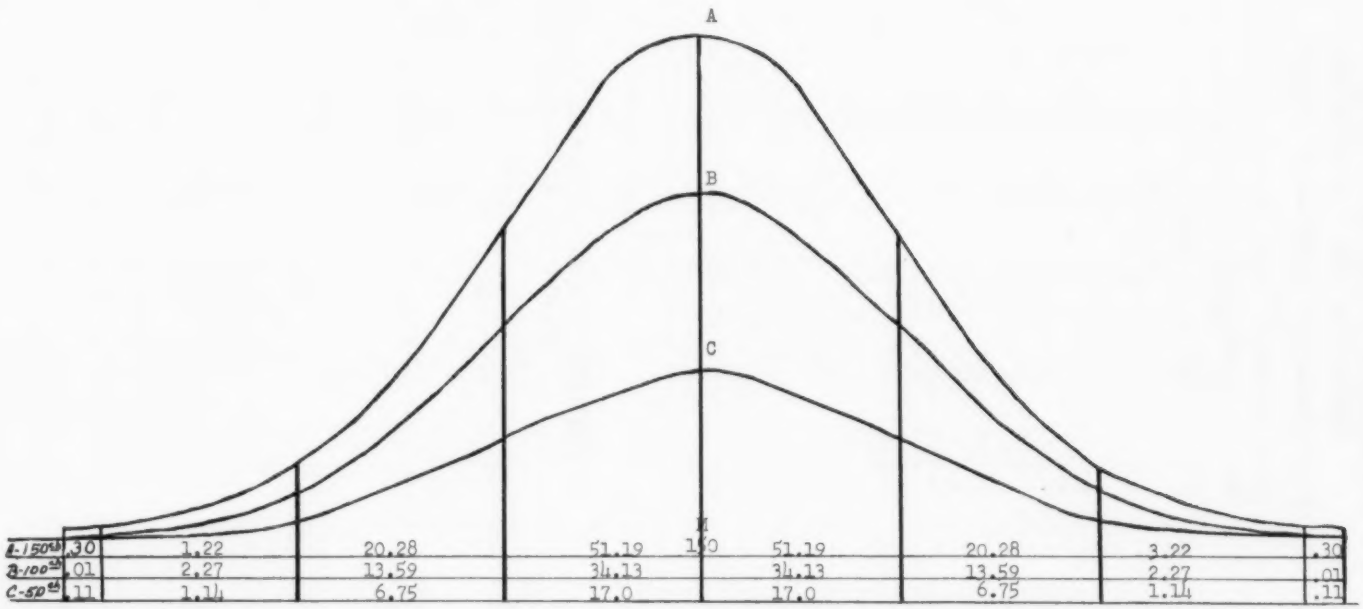
Cyclic Maturation: A Variable

The new factor appears to be variation caused by differences in cyclic maturation. Since the existence of cyclic maturation is still a matter of controversy for some researchers, a representative bibliography of research establishing cyclic maturation is appended marked with an asterisk. The length of this bibliography could be greatly extended.

By way of illustration, the curve of the growth of an individual boy was drawn (Figure D). He is the mid-individual at age seven (case 1020 from Table VIII) and is taken as the standard child. All other measurements are compared to his. Please note his pattern compared with that of a rapidly growing boy (case 3111) and a slowly growing boy

FIGURE C

ASSUMED CHANGES IN SIZE OF A THEORETICALLY NORMAL DISTRIBUTION



A-150%	.30	1.22	20.28	51.19	150	51.19	20.28	3.22	.30
B-100%	.01	2.27	13.59	34.13		34.13	13.59	2.27	.01
C-50%	.11	1.14	6.75	17.0		17.0	6.75	1.14	.11

S.D. = 7.5
R = 45

TABLE VI

COEFFICIENTS OF DISPERSION OF MID-HEIGHTS AND MID-WEIGHTS OF THE 92 HOMOGENEOUS GROUPS

AGE	HEIGHT				WEIGHT			
	CAL.		TENN.		CAL.		TENN.	
	A	B	A	B	A	B	A	B
4.0	.12	.17	.08	.14	.38	.45	.14	.44
4.5	.12	.12	.14	.15	.50	.33	.53	.38
5.0	.19	.17	.13	.15	.53	.35	.33	.51
5.5	.17	.19	.23	.28	.71	.55	.64	.59
6.0	.14	.16	.10	.20	.37	.50	.40	.70
6.5	.33	.23	.18	.21	.52	.39	.31	.50
7.0	.24	.22	.18	.25	.74	.65	.56	.50
7.5	.15	.15	.18	.29	.36	.46	.63	.58
8.0	.18	.17	.25	.21	.78	.55	.93	1.02
8.5	.15	.20	.22	.24	.52	.83	.73	.84
9.0	.19	.21	.22	.31	.54	.57	.70	.84
9.5	.20	.16	.18	.18	.58	.59	.66	.97
10.0	.27	.20	.22	.28	.70	.70	.94	1.16
10.5	.27	.18	.22	.23	.89	.81	.54	.85
11.0	.18	.15	.21	.22	.83	.53	1.03	.88
11.5	.18	.20	.23	.21	.69	1.02	.74	.63
12.0	.20	.23	.24	.25	.80	.53	1.04	.80
12.5	.20	.20	.27	.22	.71	.67	.84	.68
13.0	.19	.23	.25	.25	1.09	.63	.84	1.24
13.5	.21	.22	.22	.26	.71	.90	.91	.74
14.0	.27	.24	.29	.25	.91	.77	.84	.87
14.5	.18	.21	.18	.23	.74	.74	.64	.53
15.0	.14	.09	.18	.05	.53	.60	.66	.11

TABLE VII

DISTRIBUTION OF THE NUMBER OF CASES IN EACH OF THE 92 HOMOGENEOUS GROUPS

Size	CALIFORNIA		TENNESSEE	
	A	B	A	B
90				1
80				2
70			0	4
60	1		6	2
50	5	1	3	5
40	6	10	1	3
30	6	6	2	0
20	0	4	1	3
10	3	2	5	2
0	2		1	1
	23	23	23	23

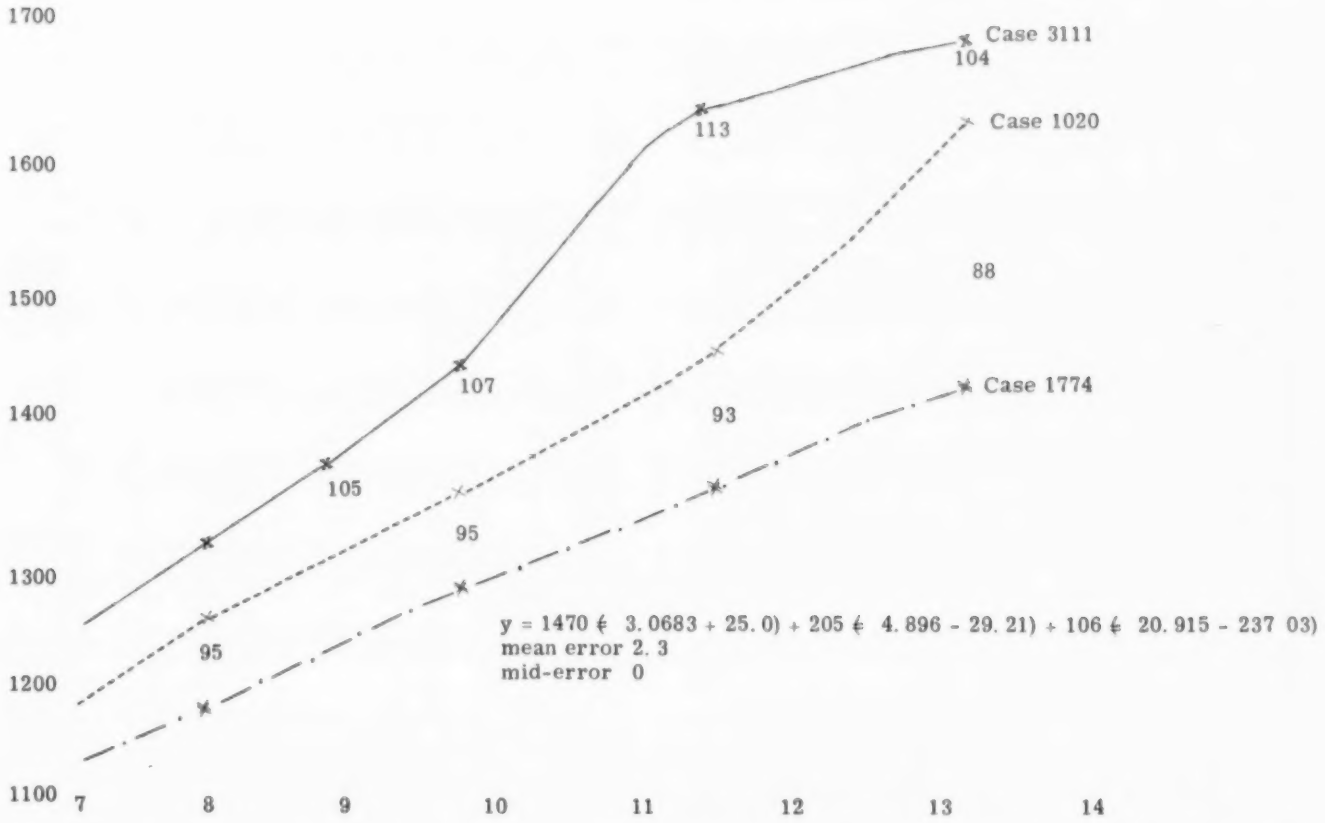
TABLE VIII

HARVARD GROWTH STUDY HEIGHTS OF FORTY-FIVE SELECTED INDIVIDUALS

Case No. \ Ages	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	
1534- II 1	1111	1211	1265	1319	1362	1480	1530	1620	1
1001-III 2	1120	1182	1229	1280	1327	1382	1438	1493	2
542- II 3	1123	1165	1217	1262	1315	1365	1465	1553	3
746-III 4	1129	1177	1221	1275	1314	1366	1393	1443	4
626-III 5	1129	1171	1236	1280	1334	1376	1432	1513	5
599-III 6	1129	1171	1210	1248	1275	1318	1360	1397	6
162-III 7	1146	1202	1243	1283	1330	1380	1452	1549	7
1882- II 8	1150	1184	1237	1284	1334	1369	1421	1474	8
2838- II 9	1152	1221	1264	1312	1351	1403	1444	1522	9
792-III10	1156	1196	1249	1285	1333	1372	1412	1455	10
119-III11	1157	1219	1274	1314	1474	1423	1480	1550	11
2848-II 12	1160	1225	1289	1339	1390	1433	1482	1545	12
1774-II 13	1162	1205	1251	1297	1336	1377	1424	1455	13
288-III14	1163	1211	1277	1335	1385	1444	1491	1543	14
648-II 15	1168	1216	1275	1322	1371	1412	1457	1482	15
791-III16	1177	1217	1270	1364	1403	1446	1490	1576	16
967-III17	1179	1246	1303	1367	1410	1465	1523	1583	17
227-II 18	1180	1240	1292	1356	1411	1472	1526	1607	18
1321-III19	1199	1259	1313	1372	141	1467	1538	1628	19
1246-III20	1200	1273	1321	1372	1413	1466	1523	1614	20
1960-III21	1202	1244	1302	1364	1424	1433	1530	1587	21
2998-II 22	12	1247	1310	1350	1412	1565	1634	1662	22
1020-III23	1204	1269	1322	1372	1423	1480	1561	1660	23
1086-III24	1206	1254	1311	1364	1412	1456	1503	1534	24
717-III25	1206	1250	1311	1356	1394	1431	1479	1532	25
1696-III26	1206	1271	1322	1368	1407	1456	1503	1549	26
30-III27	1209	1254	1315	1369	1427	1495	1596	1671	27
1450-II 28	1211	1259	1313	1358	1413	1449	1536	1623	28
431-III29	1211	1282	1330	1373	1423	1464	1506	1551	29
630-I 30	1214	1285	1334	1391	1443	1504	1582	1686	30
1276-III31	1218	1253	1305	1355	1401	1432	1480	1516	31
40-III32	1223	1260	1318	1372	1423	1475	1534	1604	32
483-II 33	1203	1291	1345	1399	1445	1502	1550	1606	33
3327-III34	1232	1283	1324	1374	1423	1474	1513	1568	34
585-III35	1237	1278	1342	1382	1436	1481	1529	1575	35
69-II36	1240	1299	1364	1420	1475	1543	1616	1710	36
1306-III37	1242	1295	1354	1397	1446	1493	1541	1582	37
1687-II 38	1253	1294	1347	1398	1434	1474	1520	1593	38
3202-II 39	1263	1330	1393	1445	1495	1570	1668	1754	39
1828-II 40	1264	1337	1404	1458	1520	1574	1646	1751	40
3111-II 41	1268	1331	1393	1466	1565	1670	1715	1727	41
407-III42	1281	1329	1403	1456	1513	1556	1620	1692	42
1313-III43	1290	1367	1411	1473	1528	1660	1701	1785	43
232-III44	1302	1361	1418	1462	1507	1566	1610	1710	44
1127-II 45	1335	1407	1467	1523	1577	1665	1738	1805	45
Range	225	243	258	276	302	348	379	409	
C.of.D.%	18.69	19.15	19.52	20.12	21.22	23.51	24.28	24.64	

FIGURE D

GROWTH CURVE OF MID-INDIVIDUAL



For illustration, the growth curve of additional individuals are drawn with the ratio of each to the mid-individual's curve shown. Note the way in which the ratios of curves to the mid-curve change at the points indicated.

(case 1774). The beginning-of-the-cycle change is clearly evident in both the upper and lower curves. The rapidly growing boy's height accelerates at ten years of age and begins to level off at twelve years. The slowly growing boy does not begin to accelerate until twelve years and then begins to level off by thirteen. The mid-individual has not begun to level off at fourteen years. Note, also, the changing ratios of the measurements of each of the boys to the mid-boy given at ages eight, ten, twelve and fourteen. The decrease in ratio of Case 1774 indicates only that his growth has been less rapid up to that point than has that of the mid-boy.

Consistency of Growth Patterns

The ratios of the heights of each of the other forty-four individuals to the mid-individual are given in Table IX. The consistency with which the patterns of these boys parallel the mid-boy is noteworthy. One of the most striking of these is that of the forty-fifth boy. The differences between each boy's ratio and the mid or standard boy from one year to the next have been computed and distributed (Table X) so that a picture can be obtained of the relationship of the height-growth pattern of these boys to each other.

Of the 315 possible comparisons, thirty-four or over 10% show no difference whatsoever. An additional 113 comparisons (47%) range from zero to plus or minus five-tenths of one percent. A range of variation no greater than one percent includes sixty-seven percent of the cases. Such a variation at eleven years of age represents a change of up to fourteen millimeters or approximately one-half of an inch. There are, however, variations up to as much as six percent. Approximately seventeen percent of the ratios vary as much as two percent of their magnitude. The largest individual variations begin at twelve years of age or about the time that the cycles begin to break. A summary of the median differences taken from Table X is shown (Figure E) beneath the coefficients of dispersion taken from Table VIII. This summary indicates that the relationship between them begins to change at eleven years of age. The fact that eleven is the approximate age of the onset of adolescence for early maturing boys indicates that the cycle of maturation is a variable. The cycle of maturation, although a well-known phenomenon, has heretofore been unrecognized as a variable.

In order to see this from still another perspective, the three-cycle exponential equation was computed (Figure D). It describes the growth of the mid-individual almost exactly. The single exception is the last point. The error here of twenty-six millimeters accounts for almost the entire difference between the mean and median error for the twelve points of the curve.

Isochrons (Naperian loglogs to the base of e and converted to remove negative numbers) are used to make the computations easier.

Note that three rather than two cycles are required and that the increase in rate of growth of the mid-boy during the third cycle is unusually great.

The ratio of 100 is used to describe the mid-boy at all points. The fact that almost all other ratios decrease suggests that the mid-boy's growth has speeded up and they therefore appear not to be growing as rapidly as he. The equation confirms this. The choice of this boy as a mid-child was not an ideal one from more than one point of view. Standard children should be selected who are representative of each of the important variables. Until they are, however, selection of the mid-child of the distribution for the standard suits our purposes adequately.

The fact that the Harvard Growth Data are longitudinal makes it possible to correct for maturation much in the same way that altitude is corrected when dealing with air pressure. Although it may be possible to account for maturation in cross-sectional data such as that collected by the Department of Agriculture it could not be done within the scope of this study.

An Attempt to Control Size

Previous discussion has shown that when size is held constant the dispersion decreases. Therefore a further attempt was made to determine the effect of group size using the Department of Agriculture data.

A card was made for each of the forty-six comparisons of socio-economic group A and B giving the size of group, as well as the mid-values and ranges of both heights and weights. These forty-six cards were then paired by age and state of residence. The pairs were then arranged in order of size of group and distributed by the differences in size (Table XI). It can be seen from this comparison that as the differences in size between the groups being compared increase, the range tends to increase also. Within the limits of the number of cases, the trend tends to be 1.01. It is probable, therefore, that if it were possible to bring the size of the group under exact control that there would be no difference attributable to socio-economic status.

Conclusions and Recommendations

Conclusion as to Effect of Socio-economic Status

The effort to determine the effect of socio-economic status on height and weight with the Department of Agriculture data is, in the last analysis, impossible in this study for two reasons:

TABLE IX

RATIOS OF THE HEIGHTS OF 44 INDIVIDUALS TO THE MID-INDIVIDUAL*

	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0
1	92.28	95.43	95.69	96.14	95.71	100.00	98.01	97.59
2	93.02	93.14	92.91	93.29	93.25	93.38	92.12	89.94
3	93.23	91.80	92.06	91.98	92.41	92.23	93.85	93.53
4	93.77	92.75	92.36	92.93	92.34	92.30	89.24	86.93
5	93.27	92.28	93.49	93.29	93.75	92.97	91.74	91.14
6	93.77	92.28	91.53	90.96	89.60	89.05	87.12	84.16
7	95.18	94.72	94.02	93.51	93.46	93.24	93.02	93.21
8	95.51	93.30	93.57	93.59	93.75	92.50	91.03	88.80
9	95.68	96.22	95.61	95.63	94.9	94.80	92.50	91.69
10	96.01	94.25	94.48	93.86	93.68	92.70	90.45	87.65
11	96.10	96.06	96.37	95.77	96.56	96.15	94.81	93.37
12	96.35	96.53	97.50	97.59	97.68	96.82	94.94	93.07
13	96.51	94.96	94.63	94.53	93.89	93.44	91.22	87.65
14	96.59	95.43	96.60	97.30	97.33	97.57	95.32	92.95
15	97.01	95.82	96.44	96.36	96.35	95.41	93.34	89.28
16	97.76	95.90	96.07	99.42	98.59	97.70	95.45	94.94
17	97.92	98.19	98.56	99.64	99.09	98.99	97.57	95.36
18	98.01	97.71	97.73	98.83	99.16	99.46	97.76	96.81
19	99.58	99.21	99.32	100.00	99.09	99.12	98.53	98.07
20	99.67	100.32	99.92	100.00	99.36	99.05	97.51	97.23
21	99.83	98.03	98.44	99.42	100.07	96.82	98.01	95.60
22	99.92	98.27	99.08	98.40	99.23	105.74	104.68	100.12
23	100 (1264)	100 (1269)	100 (1322)	100 (1372)	100 (1423)	100 (1480)	100 (1561)	100 (1660)
24	100.17	98.82	99.17	99.42	99.23	98.38	96.28	92.41
25	100.17	98.50	99.17	98.83	97.96	96.69	94.75	92.29
26	100.17	100.16	100.00	99.71	98.88	98,38	96.28	93.31
27	100.42	98.82	99.47	99.78	100.28	100.01	102.24	100.66
28	100.58	99.21	99.32	98.98	99.60	99.91	98.40	97.77
29	100.58	101.02	100.61	100.07	100.00	98.92	96.48	93.43
30	100.53	101.26	100.91	101.38	101.41	101.62	101.35	101.57
31	101.16	98.74	98.71	98.76	98.45	96.76	94.81	91.33
32	101.58	99.29	99.70	100.00	100.00	99.66	98.27	96.63
33	102.16	101.73	101.74	101.97	101.55	101.49	99.30	96.75
34	102.33	101.10	100.15	100.15	100.00	95.99	96.93	94.46
35	102.74	100.71	101.51	100.73	100.91	100.07	97.95	94.88
36	102.99	102.36	103.18	103.50	103.65	104.26	103.52	103.01
37	103.16	102.42	102.42	101.82	101.62	100.88	98.72	95.30
38	104.07	101.97	101.89	101.90	100.77	99.50	97.37	95.96
39	104.90	104.81	105.37	105.32	105.06	106.08	106.85	105.66
40	104.98	105.36	106.20	106.27	106.82	106.35	105.45	105.48
41	105.32	104.89	105.37	106.85	109.98	112.84	109.87	104.04
42	106.40	104.73	106.13	106.12	106.32	105.14	103.78	101.93
43	107.14	107.72	106.73	107.36	107.38	112.16	108.97	107.53
44	108.14	107.25	107.26	106.56	105.90	105.81	103.14	103.01
45	110.88	110.87	110.97	111.01	110.82	112.50	111.34	108.73

*The mid-individual ratios are given as 1.00

TABLE X

DISTRIBUTIONS BY AGE OF INDIVIDUAL DIFFERENCES IN STATUS INDICIES FROM THE INDICES OF THE MID INDIVIDUAL TAKEN AS STANDARD (100)

	ages							
%	8.0	9.0	10.0	11.0	12.0	13.0	14.0	Totals
6.0					1			
5.0					1			
4.5					1			
4.0					0			
3.5	1				0			
3.0	0			1	1			
2.5	0			0	0			
2.0	0			0	0	1		
1.5	0	1	1	0	0	2		
1.0	2	9	6	5	4	1		
.5	7	16	13	9	6	0	2	
0	5	6	8	9	3	1	2	
.5	6	11	9	11	14	2	7	
1.0	4	2	6	10	8	3	4	
1.5	8		0		3	11	4	
2.0	8		0		2	6	4	
2.5	2		0		0	13	7	
3.0	0		1		0	3	6	
3.5	2		1		1	2	4	
4.0							2	
4.5							1	
5.0							1	
6.0							1	
Total	45	45	45	45	45	45	45	
Median	-.63	+.62	+.37	+.22	-.72	-1.58	-2.0	

FIGURE E

RELATIONSHIP BETWEEN MEDIAN DIFFERENCES IN STATUS INDICES AND COEFFICIENTS OF DISPERSION FROM TABLE

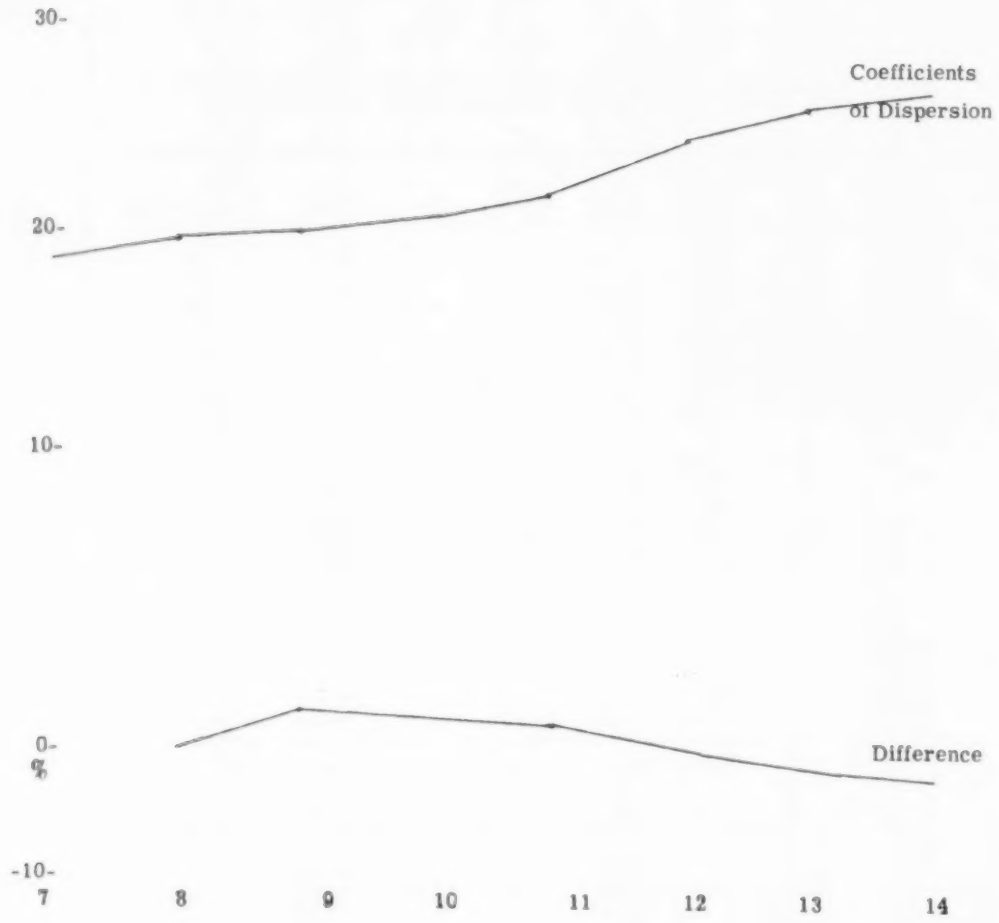


TABLE XI

DISTRIBUTIONS OF THE SOCIO-ECONOMIC RATIO A TO B IN HEIGHT BY DIFFERENCES IN THE SIZE OF THE GROUP FROM WHICH THE RATIOS WERE DERIVED

	Differences in Size						
Ratio	Exact	1	3	4-10	11-20	21-30	31 plus
1.07			1				
1.06							
1.05							
1.04		1			1	1	1
1.03					2	1	
1.02			1	2	3	1	
1.01	1		1	8	4	3	
1.00		2			2	2	1
.99		1		1	2		
.98							
.97							
.96					1		
.95							
.94							
.93							
.92							
.91							
.90							

TABLE XII

MEANS AND THEIR RATIOS OF SOCIO-ECONOMIC GROUP A to B

Boys	CALIFORNIA			TENNESSEE		
No.	Ht.A	Ht.B	Ratio	Ht.A	Ht.B	Ratio
6.	120.23	118.14	1.018	117.30	115.78	1.0131
7.	126.26	123.59	1.0216	123.94	121.78	1.0178
8.	126.13	130.25	.9681	129.46	126.83	1.0207
9.	134.13	134.66	.9960	133.68	132.12	1.0118
10.	142.74	138.82	1.0282	138.35	136.97	1.0107
11.	146.28	145.84	1.0030	141.97	141.00	1.0068
12.	152.12	149.36	1.0184	147.81	146.01	1.0123
13.	158.13	156.86	1.0080	153.20	150.92	1.0151
14.	164.00	163.05	1.0058	161.40	157.13	1.0272
Mid ratio			1.01			1.01

1. Ideal sampling methods could not always be followed in the collection of the data (Bulletin, p. 3). The selection depended upon more than statistical considerations. That is, the factors operating prevented a representative sampling. This fact is born out by the variability of the coefficients of dispersion.

2. The socio-economic classes are grouped which tends to destroy their effect.

Comparison of Results of This Study with Those Obtained by Department of Agriculture

The ratios of height measurements A to B obtained from the group data in the Bulletin (Table 63, p. 123) were calculated (Table XII). The findings of the single variable method here also agree very closely with the conventional method in which no attention is paid to the operation of variables in the results. Thus, the single variable method can be considered no less adequate or meaningful. The single variable method in addition has provided 1) a much less complex procedure, 2) twice as many comparisons for additional corroboration of results between the two states, and 3) a means for determining what variables are causing the differences.

A Further Supplementary Study

The supplementary study made with the Harvard Growth Data indicates that a further study is feasible with a minimum of time and expense. This study can be made with two groups alike in size and maturation in addition to the variables dealt with in this study. The groups will differ only in socio-economic status. The Harvard Growth Data although thoroughly collected and reported represent only a small sampling within a single state.

Avenues for Further Investigation

The observed differences in the Bulletin in terms of socio-economic status and in terms of norms or standards are imperfect because of the possible effect of many other variables for which evidence is already in existence. In considering these variables it appears profitable to begin with those which certainly effect the relation of the means from state to state and probably effect also the specific determination of socio-economic status.

In available geographic references it is shown that Tennessee is on the average 1000 feet higher than is California. In terms of the general trend of wind and clouds, California is exposed to moist air blowing across it from the Pacific while Tennessee is an inland state. California has on the average considerably less precipitation and several hundred hours of sunshine per year more than does Tennessee. The effect of these differences may be appearing in the data. The single variable method gives promise of identifying any such effects providing, of course, that the basic data are an accurate representation of reality.

At least three other variables of generally acknowledged importance come to mind: 1) The average salary and average food consumption are very different in these states. 2) A sampling of the original working schedules collected by the Department of Agriculture shows that in Tennessee both parents of over eighty percent of the children were born in that state while in California less than ten percent of the children had parents, both of whom were born in that state. 3) Ethnic stock could also be a contributing factor to differences in bodily dimensions.

When socio-economic groups A and B from California are compared with the corresponding groups from Tennessee, the California results are always shown to be superior—probably from the effects of factors just listed, but possibly these very factors may have an effect upon socio-economic status. It is beyond the scope of this study to investigate the effect of such variables.

Summary

1. The single variable method is an effective way of disclosing previously unrecognized variables, and so far as the data permits, of determining the relationship between them.

2. The single variable method is simpler, yet it achieves similar results to those secured by complex mass statistical analyses.

3. The coefficient of dispersion is a useful statistic for the purpose of discovering variables.

4. It is feasible to substitute observations of facts for logical deductions from mass data.

5. Group size and cycle of maturation are variables which may effect any mass study involving measurements of children in which they are not controlled.

6. A generalization supported by the activity of this study is that the single variable principle is both a guide to absolute truth under the given conditions and an indication of the degree to which it is being obtained.

7. The use of the single variable technique in this study shows that it is not too much to expect that with satisfactory care taken in the collection of data, the discovery of law in the life sciences is feasible.

Recommendations

The specific goal of the pilot study was to determine the likelihood of success of the proposed study of variables. The basic data from the Department of Agriculture is judged to be inadequate to determine the effects involved as had been

hoped and for the reasons shown. Therefore, it is recommended that the further use of these data for single variable studies not be attempted.

It is further recommended that the Harvard Growth Data be used for a single variable study of the effect of socio-economic status within a single state and that a study similar to the present one be made. The data on bodily dimensions and mental development are available on campus. The expense would therefore be relatively minor.

The findings from such a study should, among other things, enable the planning of a further study which could result in the development of nationwide norms in physical, mental, social and educational development.

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PRESSURE ON POINT AND BARREL OF A WRITING INSTRUMENT*

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THE PRESENT study is a further extension of investigations of pressure phenomena in handwriting conducted by members of a Committee for Research in Basic Skills at the University of Wisconsin. Two previous investigations reported by Harris and Rarick (1, 2) were limited to the study of pressure applied to the point of a writing instrument. The studies were concerned with the methodology of examining point pressure phenomena and the relationship between point pressure and legibility in handwriting.

The previous Wisconsin investigators were limited to the study of pressure on point because, as Harris and Rarick (1) have pointed out, no satisfactory method of mesuring pressure exerted upon the barrel of a writing instrument had been devised. The problem of adequately measuring pressure exerted upon the point of a writing instrument was, however, solved by recording pressure through the use of a platen and strain guages coupled with a vacuum tube amplifier and a recording oscilliograph. It appeared that a comparable technique might be employed in measuring pressure on barrel if the appropriate instrumentation were available.

Consequently, a grip pressure transducer pen was developed by the Parker Pen Company for experimental purposes. The development of the transducer pen made possible 1) the study of pressure applied to the barrel as well as to the point of a writing instrument and 2) the examination of possible interrelationships between point and barrel pressure.

The primary purpose of this study was to examine barrel and point pressure phenomena in an attempt to determine what relationships and pressure patterns appear to exist.

Specifically, answers to three questions were sought. 1) What is the relationship between pressure applied to the point and pressure applied to the barrel of a writing instrument? 2) What inter-finger barrel pressure patterns can be differentiated for individuals? 3) Will barrel pressure patterns tend to be different for adults and for children? Logically, it might be presumed that light point pressure would go with light barrel pressure; that an individual's index finger, middle finger, and thumb would exert about equal pressure on barrel; or that handwriting becomes a more personalized act as a child matures, and, consequently, more variable for a group of adults. Empirical answers to the questions were sought.

Method

Population and design. —In order to determine whether pressure patterns tend to differ as familiarity with the handwriting act increases, Ss were chosen from three educational levels: grade four, grade six, and college. The choice of these three levels was based upon the following assumptions. Children in grade four are, in most schools, still in the transitional period between manuscript and cursive writing; they are in the early stages of establishing their cursive writing habits and skills. By grade six, the children are skilled in cursive writing and apt to be writing as well as, or better than, they will write at any period. College students have had ten years or more experience with cursive writing; their writing habits are well established.

Subjects were run in blocks of ten, with five males and five females in each block. Two blocks of ten Ss were run from each grade level. The college Ss were upper-class undergraduates and graduate students enrolled in education courses at the University of Wisconsin. They were chosen at random and asked to participate in the study. Ss from grades four and six were students in the laboratory school. They were chosen at ran-

* Footnotes will be found at the end of the article.

dom. Data from four sixth-grade Ss had to be discarded due to malfunction of the apparatus. Consequently, 20 college students, 20 fourth graders, and 16 sixth graders participated in the study.

Instrumentation. —Three basic instruments were employed in the study: a specially constructed table equipped with a pressure sensing platen, an 8-channel GME polygraph, and the grip pressure transducer pen. The S was unable to watch the recording of pressure since the polygraph was turned away from him, yet E was able to observe S's performance and make adjustments when necessary.

The table and pressure sensing platen were used in the previous Wisconsin studies and have been described by Harris and Rarick (1). Briefly, it is a standard height table with a pressure sensing platen mounted flush with the surface in a rotating disk, which permits placement of the platen at a comfortable writing angle for each S. The platen rests upon four strain guages which measure change in force exerted upon the platen.

For the present study, the crucial instrument was the grip pressure transducer pen. Development of the pen made the study of finger pressure upon the barrel of a writing instrument through the use of electronic equipment feasible. The advantages of measuring pressure phenomena through the use of such equipment over devices formerly used were discussed by Harris and Rarick (1). The pen, the only one of its kind, was developed for the Committee for Research in Basic Skills by the Experimental Process Lab of the Parker Pen Company, Janesville, Wisconsin.

The transducer pen, like the platen, employs strain guages to measure pressure. With the pen, pressure exerted by each of three fingers—thumb, middle, and index—to segments of the barrel of the instrument can be measured. Figure 1 is a photograph of the transducer pen and the connector plugs. Physical specifications for the pen are given in Table I.

The tapered plastic shell is held tightly at the rear, on a shoulder of the brass rod structure. It fits in contact with the raised ring on the segments near the forward end, slightly preloading the segments. It also carries a replaceable ball point. The shell is slit, over the segment slits, in the tapered section to increase its compliance.

Electrically, two SR-4#a-18 strain guages are mounted on each segment beam. These guages are active, in extension, comprising two arms of a bridge on each beam. Six additional similar guages are contained in a case mounted on the rear end of the structure. These guages comprise the inactive arms of the bridges. Therefore, there is a complete bridge, internally connected, on each segment beam. Four leads of each bridge (two input-two output) are brought out to a four-pin plug.

The vacuum tube amplifier and recording oscillograph used in the earlier Wisconsin studies were replaced in the present study by a Gilson Medical Electronics 8-channel polygraph with two strain guage carrier units.[1] The strain guage carrier units were used in recording pressure applied to the platen and to the barrel of the transducer pen. Since just two strain guage carrier units were available, one was used to record point pressure at all times while the other recorded thumb, index finger, and middle finger pressure for each S.

Pressure records produced by the polygraph were on standard EEG paper. The record of one S is shown in Figure 2. In the illustration, pressure exerted upon the barrel of the transducer pen by the S's index finger was simultaneously recorded with pressure applied to the platen by the point of the pen. The upper ink line shows variation in point pressure and the lower line shows variation in index finger pressure. Greater point pressure causes deviations down from the base, whereas greater finger pressure causes deviations up from the base.

The instrument was carefully calibrated for the platen and for each finger segment of the transducer pen. This was done by placing standard 100, 200, 300, 400, and 500 gram weights on the appropriate pressure points and noting the magnitude of the deviation from the base line caused by the several weights. This made it possible subsequently to convert centimeters of deviation from base into grams of pressure applied to the various segments.

Task. — The S was simply asked to write the standard sentence used in the previous Wisconsin studies: "The quick brown fox jumps over the lazy dog." This was shortened to "The brown fox jumps" for the fourth grade and sixth grade Ss. Since exploratory studies had shown that the Ss pressure pattern was stabilized by the second or third write-through, each S wrote the standard sentence three times in each sequence.

It was necessary to have each S write through three sequences: one sequence for each of the three fingers. As stated above, since only two strain gauge carrier units were available, point pressure plus one finger pressure were recorded on any one sequence. To change fingers, E merely had to change the connector plugs joining the transducer pen and the polygraph and balance the polygraph. Thus, it was possible for most Ss to complete the task in about ten minutes.

The sequence followed with each S can be briefly described. The S was shown the instruments and questions were answered. He was made comfortable in the adjustable chair at the table, and

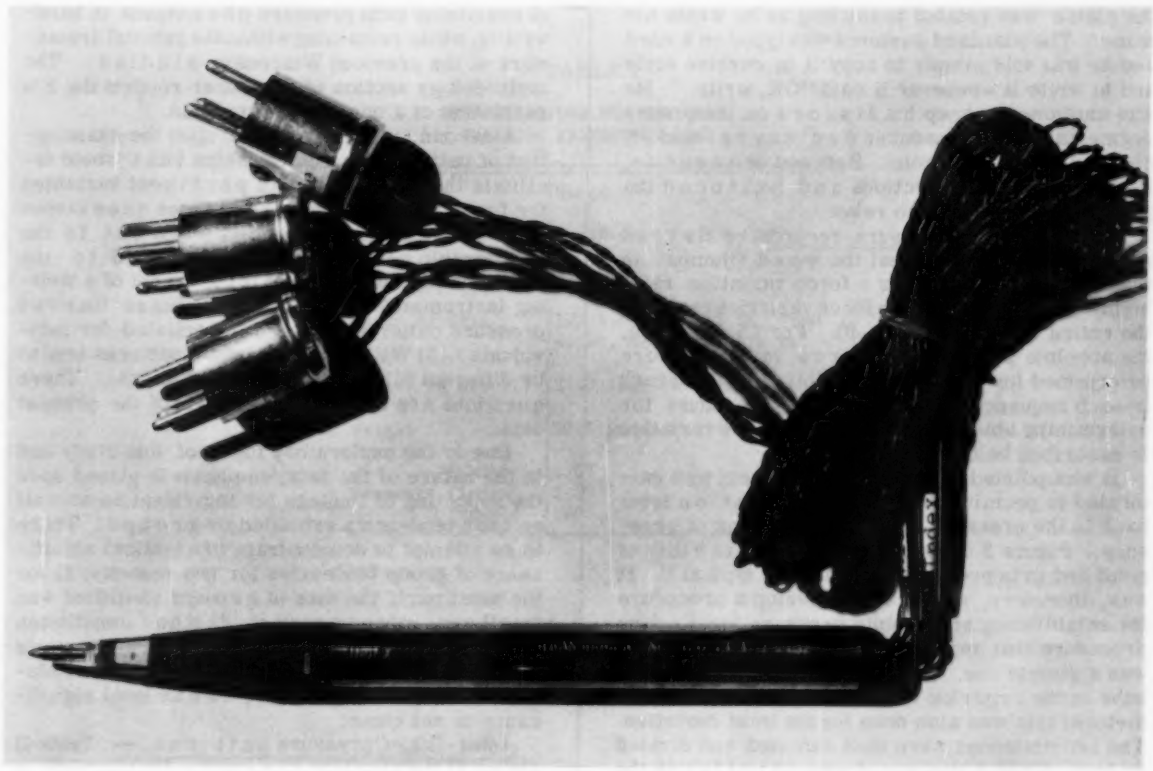

FIGURE 1. Grip Pressure Transducer Pen.

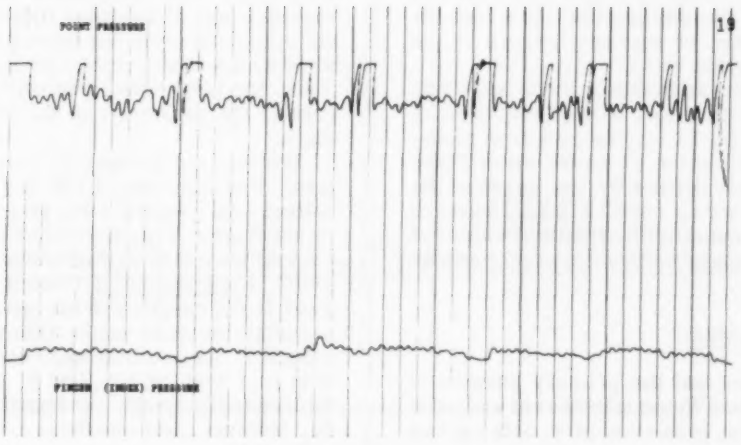

FIGURE 2. Polygraph Pressure Record of a Typical Subject.

the platen was rotated to suit him as he wrote his name. The standard sentence was typed on a card and he was told simply to copy it in cursive style and to write it whenever E said "OK, write." He was cautioned to keep his fingers on the proper segments of the transducer pen barrel and E checked this as he wrote. Between sequences, while E changed connections and balanced the polygraph, S was told to relax.

Analysis of the pressure records. — Harris and Rarick (2) showed that the word "jumps" in the standard sentence has a force variation ratio highly correlated with the force variation ratio for the entire sentence (about .9). For this reason, the absolute pressure and force variation were determined for "jumps" in the third write-through in each sequence for each S. The procedure for determining absolute pressure and force variation is described below.

It was pointed out that the instrument was calibrated to permit conversion of deviation from base in the pressure record into grams of pressure. Figure 2 demonstrates the variability of point and grip pressure applied by a typical S. It was, therefore, necessary to develop a procedure for establishing an absolute pressure level. The procedure that appeared to work satisfactorily was a simple one. The greatest deviation from base in the criterion word was measured in centimeters; this was also done for the least deviation. The two distances were then summed and divided by two. When a line was drawn parallel to the base at the resultant average distances, in most cases that line had equal areas above and below it. This is illustrated in Figure 3. In instances where there was disparity in areas above and below the average line, the line was adjusted up or down to correct the disparity. The distance between the base and the average line could then be converted to absolute, or average, pressure in grams for the criterion word.

The procedure for determining force variation is similar, but not identical, to that employed by Harris and Rarick (1, 2). In the present study, the length of the line of the pressure record (see Figure 2) was simply divided by the length of the base line of the criterion word to get the force variation ratio. This simplified method appeared to result in an adequate estimate of force variation.

Results and Discussion

It has been stated that the primary purpose of the present study was to examine barrel and point pressure phenomena in an attempt to determine what relationships and pressure patterns appear to exist. Essentially, then, the study was exploratory. A major focus was upon the methodology of examining grip pressure phenomena in handwriting while remaining within the general framework of the previous Wisconsin studies. The methodology section of this paper reports the E's resolution of a number of problems.

A second major focus was upon the examination of patterns and relationships that would facilitate the identification of pertinent variables for further study. Answers to three questions were sought in this connection. 1) What is the relationship betwwen pressure applied to the point and pressure applied to the barrel of a writing instrument? 2) What inter-finger barrel pressure patterns can be differentiated for individuals? 3) Will barrel pressure patterns tend to be different for adults and for children. These questions are examined in the light of the present data.

Due to the exploratory focus of this study and to the nature of the data, emphasis is placed upon the reporting of findings for individual Ss as well as upon tendencies exhibited by groups. There is no attempt to demonstrate statistical significance of group tendencies for two reasons: 1) for the most part, the size of groups identified was small and, more important, 2) what constitutes an actual behavioral difference in grip pressure is not known—it would be fruitless to claim statitistical significance where behavioral significance is not clear.

Inter-finger pressure patterns. — Table II shows 1) the absolute pressure (in hundreds of grams) applied by each of three fingers—thumb (T), index (I) and middle (M)— to the barrel of the transducer pen; 2) the absolute pressure applied to the point of the pen (the mean of the three measures obtained); and 3) the force variation of each of the three fingers and the point. Force variation was determined by dividing the length of the polygraph pressure record for the criterion word by the length of the corresponding base line. Thus, the larger the force variation ratio, the greater the variability of the pressure applied by the S.

Subjects are grouped by finger pressure pattern. For example, T I M is a finger pressure pattern: the greatest absolute pressure is exerted by the thumb, with the index and middle fingers ranking second and third in absolute pressure applied. Examination of Table II provides an answer to the question: What inter-finger barrel pressure patterns can be differentiated for individuals? Six patterns were demonstrated: T I M, T M I, I T M, M I T, I M T and M T I. This includes all possible combinations. Most of the Ss, however, fell into three groups: T I M, T M I, and I T M.

In some cases (marked by asterisks in Table II) the absolute pressure was the same for two

TABLE I

SPECIFICATIONS FOR THE GRIP PRESSURE TRANSDUCER PEN

Shape	Round
Length	5-7/8 in.
Thickness	7/16 in.
Range of Grip	1/2 in. to 1-1/2 in. from point. Median at 3/4 in.
Center of Gravity	2.60 in. from point
Weight	30.5 grams
Segments (Thumb	110°
Segments (Index	110°
Segments (Middle	140°

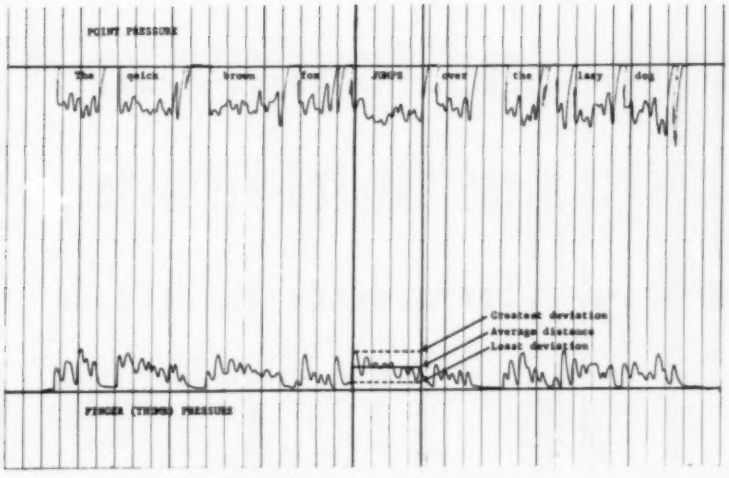

FIGURE 3. Polygraph Record Showing Analysis of the Criterion Word.

TABLE II

ABSOLUTE PRESSURE AND FORCE VARIATION FOR EACH SUBJECT (GROUPED BY FINGER PRESSURE PATTERN)

		Pressure				Force Variation			
Level	Sex	T	I	M	Point	T	I	M	Point
Adult	F	2.00	1.75	1.00	2.3	1.1	1.2	1.0	2.6
	M	3.25	3.00	2.50	2.0	1.6	1.0	1.1	1.8
	F	4.00	2.00	1.50	1.0	1.9	1.5	1.0	1.7
	M	5.25	5.00	4.25	2.5	1.3	1.0	1.3	3.3
	F*	4.25	4.25	3.75	1.25	1.7	1.1	1.2	3.0
Grade 6	F	5.25	3.5	2.5	1.2	1.7	1.2	1.0	1.3
	M	4.5	3.5	0.75	1.9	1.6	1.2	1.0	1.4
	M*	2.5	2.0	2.0	1.3	2.2	1.5	1.1	2.0
	M*	5.5	2.25	2.25	1.5	2.5	1.2	1.1	2.4
	F*	2.25	2.0	2.0	2.3	1.1	1.3	1.0	1.3
	M	8.75	3.5	0.5	3.3	1.2	1.8	1.0	2.7
	F	9.0	5.0	3.25	1.75	1.1	2.1	1.4	2.6
Grade 4	M	5.0	4.25	3.25	3.3	1.4	1.1	1.3	1.8
	F	5.0	4.0	3.5	1.75	1.1	1.2	1.1	1.6
	F	3.25	2.5	2.0	1.2	1.1	1.4	1.0	1.2
	F	3.0	2.25	2.0	1.2	1.4	1.2	1.0	1.1
	M	6.25	3.50	2.75	1.3	1.3	1.1	1.1	1.3
	M	5.0	3.0	2.75	1.9	1.5	1.0	1.5	1.4
	F	4.25	3.25	2.5	1.5	1.1	1.1	1.0	1.7
	F	5.25	4.75	3.25	1.9	1.2	1.3	1.1	1.3
	F	3.5	2.75	1.0	1.2	1.1	1.1	1.0	1.1
	M*	3.0	3.0	3.0	2.1	1.1	1.2	1.2	1.2

*Absolute pressure same for two fingers.

TABLE II--CONTINUED

		Pressure				Force Variation			
Level	Sex	T	M	I	Point	T	M	I	Point
Adult	F	9.00	4.00	1.75	2.7	1.2	1.3	1.2	3.3
	M	4.5	3.00	2.75	1.3	1.3	1.3	1.2	2.0
	F	7.00	3.00	1.25	1.6	1.0	1.6	1.0	1.6
	F	3.75	2.25	1.75	1.0	1.3	1.1	1.3	1.7
	F	8.75	4.50	1.25	2.25	2.7	1.9	1.1	2.0
Grade 6	F	8.75	5.5	2.5	1.75	1.2	1.1	1.0	2.4
	F	8.5	3.75	2.5	2.4	1.2	1.3	1.0	3.6
	M	3.75	2.75	2.25	1.6	1.3	1.3	1.2	1.6
	M*	3.5	3.5	2.5	1.2	1.8	1.3	1.3	1.6
	M	7.25	4.0	3.25	1.75	1.4	1.2	1.3	2.4
Grade 4	M	6.50	4.75	3.25	3.0	1.3	1.3	1.2	1.6
	F	5.25	3.75	1.50	2.3	1.3	1.1	1.0	1.6
	F	5.75	2.75	1.25	0.7	1.2	1.1	1.0	1.2
	M	7.25	3.25	2.0	2.6	1.0	1.2	1.0	1.4
	M	5.25	3.0	2.75	3.8	2.0	1.2	1.2	1.7
	M	5.0	3.0	2.25	1.3	1.6	1.2	1.1	1.6
Level	Sex	I	T	M	Point	I	T	M	Point
Adult	M	5.25	3.0	2.00	1.3	5.0	2.1	1.1	2.5
	F	4.50	2.25	0.75	1.5	1.1	1.0	1.0	1.9
	M	5.25	3.25	1.50	1.9	1.1	1.3	1.1	3.1
	M	5.00	2.50	2.25	2.0	1.6	1.1	1.5	1.6
	M	2.00	1.50	0.75	1.5	1.7	1.2	1.0	1.6
	F	6.25	6.00	3.50	1.6	2.0	2.0	1.2	1.9
	M	3.00	2.00	1.50	1.2	1.6	2.3	1.2	2.6
Grade 6	M	4.75	1.5	1.0	1.25	1.6	1.5	1.1	1.3

*Absolute pressure same for two fingers.

TABLE II--CONTINUED

		Pressure				Force Variation			
Level	Sex	I	T	M	Point	I	T	M	Point
Grade 4	F	5.5	4.0	2.5	1.0	1.2	1.2	1.1	1.3
	M**	5.25	3.5	2.75	2.0	1.1	1.8	1.1	1.4
	F	6.0	5.0	3.0	3.7	1.2	1.2	1.2	1.5
	M**	6.25	3.75	3.0	4.1	1.5	1.1	1.1	1.2
Level	Sex	M	I	T	Point	M	I	T	Point
Adult	M	2.0	1.75	1.5	1.25	1.1	2.0	1.4	3.9
Grade 6	F*	1.5	1.5	1.0	0.75	1.0	1.1	1.0	1.1
	F	3.0	2.75	2.8	2.8	1.3	1.2	1.1	5.7
Level	Sex	I	M	T	Point	I	M	T	Point
Adult	F	6.25	5.0	3.5	3.4	1.0	1.3	1.2	3.5
	M	6.0	3.0	2.5	3.5	2.2	1.4	1.7	3.8
Level	Sex	M	T	I	Point	M	T	I	Point
Grade 6	F	5.25	4.75	1.0	3.7	1.2	1.1	1.0	2.5

*Absolute pressure same for two fingers.
**S was left handed.

fingers. These Ss were grouped with the pattern most nearly approximated. Here, of course, the reliability of the pattern group placement is questionable. Informal study, however, has shown that the larger the inter-finger differences in absolute pressure, the greater the reliability. This underscores the notion that what constitutes a behavioral difference in absolute finger pressures needs to be determined.

Table III presents the mean pressure and force variation for each finger pressure pattern group by grade level. The range of absolute pressures is also indicated.

It appears that one conclusion can be drawn with some confidence from Tables II and III: inter-finger barrel pressure patterns can, indeed, be demonstrated. There is a marked tendency for Ss to fall in the T I M, T M I, and I T M patterns, but all possible patterns were demonstrated. In addition, an implication seems clear. Even when Ss from a particular pattern only are considered, there is great between-S disparity between barrel pressure exerted by each of the three fingers. It would appear to be illogical, then, to sum pressures across fingers to obtain a mean barrel pressure for a subject.

Table IV shows the distribution of Ss to the several grip patterns on the basis of grade level and sex. With the possible exception of the I T M pattern, males and females appear to be fairly evenly distributed over the variety of grip patterns. This breakdown by grade level permits examination of another of the questions raised: Will barrel pressure patterns tend to be different for adults and for children? Looking at the I T M and the T I M patterns, it appears that there may be some tendency for a difference to exist. The implication would appear to be that studies should not lump Ss from different grade levels together without further investigation.

Point and finger pressure relationships. — Table V presents the finger/point pressure ratio, by grade level, for the three dominant grip pressure patterns. The finger/point pressure ratio is simply mean finger pressure divided by mean point pressure (see Table III). Examination of the table suggests an answer to the question: What is the relationship between pressure applied to the barrel of a writing instrument? It can be seen in Table V that 2.1 to 3.8 times the pressure is exerted by the dominant pressure finger (thumb or index) as by the point of the writing instrument; pressure exerted by the medium pressure finger is 1.2 to 2.3 times that exerted by point; and the low pressure finger exerts 0.8 to 1.5 times the pressure exerted by the point. There is little between-finger overlap in the finger/point pressure ratios; that is, the dominant, medium, and low pressure fingers are quite distinct from each other as far as relationship to point pressure is concerned. Obviously, however, the actual finger—thumb, index, middle—exerting the dominant, medium, or low pressure varies from pattern to pattern.

Logically, it would seem reasonable that Ss who exhibit low grip pressure might exhibit low point pressure and that Ss who exhibit high grip pressure might exhibit high point pressure. Whether this would be demonstrated psychologically, however, was not known. Also, if Ss can be categorized according to high or low grip (barrel) and point pressure, the effect of various combinations of high and low grip and point pressures could profitably be examined by further study. Consequently, an attempt was made to categorize Ss according to high or low grip and point pressure.

Two factors complicated this attempt to categorize Ss. 1) Since the pressure exerted by each of three fingers is quite different for a particular S, each of the three fingers must be considered in examining grip pressure. 2) A referent must be selected to determine what constitutes high and what constitutes low grip and point pressures. These factors were considered in the categorizations shown in Table VI; a rationale for the categorizations follows.

The mean point and finger pressures for each particular grade level-finger pressure pattern (see Table III) were taken as the referent points. Thus, when a S's finger or point pressure was above the group mean, this was taken to denote high pressure; finger or point pressure below the group mean was taken to denote low pressure. Table VI shows how each S was rated for high (+) or low (-) pressure applied by each individual finger and by the point of the pen. Thus, if a S rated a plus for each finger and a plus for point, he was categorized as H (high grip pressure and high point pressure). Likewise, if a S rated a minus for each finger and a minus for point, he was categorized as L (low grip pressure and low point pressure).

Some Ss were categorized as H* or L* (with an asterisk); in these cases a clear-cut high or low categorization was marred by the deviation of one finger from an otherwise consistent pressure level. A few Ss were categorized X. In these cases there was not a consistent point and grip pressure level; rather, there was consistently high (or low) finger pressure opposed to low (or high) point pressure. Only Ss exhibiting the three most common finger pressure patterns (T M I, T I M, I T M) were categorized; the I T M Ss in grades four and six were dropped because of only one S in grade six and the left-handers in grade four.

Table VII presents a summary of the categorizations shown in Table VI. Of a total of 45 Ss

TABLE III

MEAN PRESSURE AND FORCE VARIATION FOR EACH GRADE LEVEL BY PATTERN

		Pressure				Force Variation			
Level	N	T	M	I	Point	T	M	I	Point
Adult	5	6.6 9.00-3.75	3.35 4.50-2.25	1.75 2.75-1.25	1.77 2.70-1.00	1.5 2.70-1.00	1.44 1.90-1.10	1.16 1.30-1.00	2.1 3.30-1.60
Grade 6	5	6.4 8.75-3.50	3.9 5.50-2.75	2.6 3.25-2.25	1.7 2.40-1.20	1.4 1.80-1.20	1.24 1.30-1.10	1.16 1.30-1.00	2.3 3.60-1.60
Grade 4	6	5.8 7.25-5.00	3.4 4.75-2.75	2.2 3.25-1.25	2.2 3.80-0.70	1.4 2.00-1.00	1.2 1.30-1.10	1.1 1.20-1.10	1.5 1.70-1.20
Level	N	T	I	M	Point	T	I	M	Point
Adult	5	3.75 5.25-2.00	3.20 5.00-1.75	2.6 4.25-1.00	1.81 2.50-1.00	1.52 1.90-1.10	1.16 1.50-1.00	1.12 1.30-1.00	2.5 3.30-1.70
Grade 6	7	5.4 9.00-2.25	3.1 5.00-2.00	1.9 3.25-0.50	1.9 3.30-1.20	1.6 2.50-1.10	1.5 2.10-1.20	1.1 1.40-1.00	2.0 2.70-1.30
Grade 4	10	4.4 6.25-3.00	3.3 4.75-2.25	2.6 3.50-1.00	1.7 3.30-1.20	1.23 1.50-1.10	1.17 1.40-1.00	1.13 1.50-1.00	1.37 1.80-1.10

TABLE III--CONTINUED

		Pressure				Force Variation			
Level	N	I	T	M	Point	I	T	M	Point
Adult	7	4.46 6.25-2.00	2.93 6.00-2.00	1.75 3.50-0.75	1.57 2.00-1.20	2.0 5.00-1.10	1.57 2.30-1.10	1.10 1.50-1.00	2.2 2.60-1.60
Grade 6	1	4.75	1.5	1.0	1.25	1.6	1.5	1.1	1.3
Grade 4	4	5.8 6.25-5.25	4.1 5.00-3.50	2.9 3.00-2.50	2.7 4.10-1.00	1.3 1.50-1.10	1.3 1.80-1.10	1.1 1.20-1.10	1.4 1.50-1.20
Level	N	M	I	T	Point	M	I	T	Point
Adult	1	2.0	1.75	1.5	1.25	1.1	2.0	1.4	3.9
Grade 6	2	2.25 3.00-1.50	2.1 2.75-1.50	1.9 2.80-1.00	1.8 2.80-0.75	1.15 1.30-1.00	1.15 1.20-1.10	1.05 1.10-1.00	3.4 5.70-1.10
Level	N	I	M	T	Point	I	M	T	Point
Adult	2	6.12 6.25-6.00	4.0 5.00-3.00	3.0 3.50-2.50	3.45 3.50-3.40	1.6 2.20-1.00	1.35 1.40-1.30	1.45 1.70-1.20	2.6 3.80-3.50
Level	N	M	T	I	Point	M	T	I	Point
Grade 6	1	5.25	4.75	1.0	3.7	1.2	1.1	1.0	2.5

TABLE IV

GRADE LEVEL AND SEX OF SUBJECTS BY GRIP PATTERN

Level	I T M			T M I			T I M		
	M	F	Σ	M	F	Σ	M	F	Σ
A	5	2	7	1	4	5	2	3	5
6	1	0	1	3	2	5	4	3	7
4	2(L)	2	4	4	2	6	4	6	10
Σ	8	4	12	8	8	16	10	12	22

Level	M I T			M T I			I M T		
	M	F	Σ	M	F	Σ	M	F	Σ
A	1	0	1	0	0	0	1	1	2
6	0	2	2	0	1	1	0	0	0
4	0	0	0	0	0	0	0	0	0
Σ	1	2	3	0	1	1	1	1	2

(L) Both Ss were left handed.

TABLE V

GRIP/POINT PRESSURE RATIO FOR EACH GRADE LEVEL BY PATTERN

Level	Pattern								
	T	M	I	T	I	M	I	T	M
	T/Pt	M/Pt	I/Pt	T/Pt	I/Pt	M/Pt	I/Pt	T/Pt	M/Pt
A	3.7	1.9	0.9	2.1	1.8	1.4	2.8	1.9	1.1
6	3.8	2.3	1.5	2.8	1.6	1.0	3.8	1.2	0.8
4	2.6	1.5	1.0	2.6	1.9	1.5	2.1	1.5	1.1

TABLE VI

CATEGORIZATION OF SUBJECTS BY HIGH OR LOW GRIP AND POINT PRESSURE
(See Text for Explanation)

Grade 4

Sex	T	M	I	Pt	Category	Sex	T	I	M	Pt	Category
M	+	+	+	+	H	M	+	+	+	+	H
F	-	+	-	+	None	F	+	+	+	+	H
F	Same	-	-	-	L	F	-	-	-	-	L
M	+	-	-	+	None	F	-	-	-	-	L
M	-	-	+	+	None	M	+	+	+	-	X
M	-	-	Same	-	L	M	+	-	+	+	H*
						F	-	-	-	-	L
						F	+	+	+	+	H
						F	-	-	-	-	L
						M	-	-	+	+	None

Grade 6

Sex	T	M	I	Pt	Category	Sex	T	I	M	Pt	Category
F	+	+	-	Same	None	F	-	+	+	-	None
F	+	-	-	+	None	M	-	+	-	Same	None
M	-	-	-	-	L	M	-	-	+	-	L*
M	-	-	-	-	L	M	+	-	+	-	None
M	+	+	+	+	H	F	-	-	+	+	None
						M	+	+	-	+	H*
						F	+	+	+	-	X

Adults

Sex	T	M	I	Pt	Category	Sex	T	I	M	Pt	Category	Sex	I	T	M	Pt	Category
F	+	+	Same	+	H	F	-	-	-	+	X	M	+	+	+	-	X
M	-	-	+	-	L*	M	-	-	-	+	X	F	+	-	-	-	L*
F	+	-	-	-	L*	F	+	-	-	-	L*	M	+	+	-	+	H*
F	-	-	Same	-	L	F	+	+	+	+	H	M	+	-	+	+	H*
M	+	+	-	+	H*	F	+	+	+	-	X	M	-	-	-	-	L
												F	+	+	+	+	H
												M	-	-	-	-	L

considered, 35 were classified as H, L, or X. The remaining ten did not clearly fit into any of the categories as they are defined here. There does not appear to be any striking overall sex difference. On the other hand, grade four females appear to have a disproportionate number of Ss in the L classification, and grade six females for some reason appear not to have been classifiable at all. Two conclusions seem reasonable: 1) a substantial number of Ss can clearly be classified by the procedure outlined; and 2) in general, high point pressure goes with high grip pressure and low point pressure goes with low grip pressure—but there are exceptions.

Force variation. —Harris and Rarick (1) found that force variation was more closely related to legibility and speed in handwriting than was absolute point pressure. In the present study, force variation was examined in relation to finger pressure pattern, grade level, and absolute pressure. Only in the latter case did there appear to be an orderly relationship. Table VIII demonstrates this relationship between force variation and finger pressure. The inter-finger rankings by absolute pressure and by force variation for pressure patterns within grade levels are identical.

It is true, of course, that the higher the absolute pressure, the greater is the possibility for variation (magnitude of deviation from base, or zero, pressure). On this basis, the demonstrated results— the greater the absolute finger pressure, the greater the force variation for that finger— might be anticipated. Yet, it is reasonable to point out that the finger exerting the dominant pressure may be the "steering" finger in the handwriting act, and, consequently, exhibit the greatest force variation due to push-pull movements. Identification of a "steering" finger within each finger pressure pattern could prove to be the critical factor in any future demonstration of relationships between finger pressure pattern and, say, legibility in handwriting.

Conclusions and implications. —The results of the present study warrant several conclusions which, in turn, have implications for the design and execution of further studies of point and grip pressure in handwriting.

1. The fundamental conclusion to be drawn from the study as a whole is that finger pressure as well as point pressure can, indeed, be measured through the use of electronic instrumentation. The grip transducer pen makes feasible the study of barrel pressure applied by the individual fingers of a single S without unduly disrupting the normal handwriting act.

2. There is great between-S variability in finger pressure patterns exhibited; all possible combinations of thumb, middle, and index finger were demonstrated. There is, however, a marked tendency for Ss to fall in the T I M, T M I, and I T M patterns.

3. When the Ss within the most common finger pressure pattern groups are considered, there appears to be a) a tendency toward a grade level differential in the I T M and T M I patterns; and b) no sex difference within patterns. The pattern differential for different grade levels should be examined further. The differential could be due to differences in early instruction— assuming that early patterns persist in adults — or to adaptation in grip due to any of a wide variety of reasons. In either case, findings would have implications for instructional practice.

4. The inter-finger absolute pressures exhibited by individual Ss are widely varied. The clear implication is that the absolute pressures for the three fingers cannot logically be summed to determine an absolute barrel pressure; nor would any one finger provide an adequate indication of barrel pressure exerted by a S.

5. There is a distinct finger/point pressure ratio for each finger when dominant, medium, and low pressure fingers are considered in the ratios for the three common finger pressure pattern groups. However, when the actual fingers— thumb, middle, or index finger rather than the dominant, medium, or low pressure finger— are considered in the ratios, there is almost absolute overlap in the range of finger/point pressure ratios. It appears, then, to be of little value to examine finger-point pressure relationships without first having determined finger pressure patterns of the Ss being studied.

6. Even when all three fingers are taken into account, a majority of Ss can be classified according to high or low grip and point pressure. In general, high point pressure is accompanied by high grip pressure and low point pressure is accompanied by low grip pressure; but Ss can be identified who exhibit low point and high grip pressure or high point and low grip pressure. Identification and study of Ss in the various categories could yield interesting and valuable results; for example, point and grip pressure could be systematically varied in studies of motor control, legibility of handwriting, speed of writing, etc.

7. The greater the pressure applied to barrel by a particular finger, the greater the variation in pressure (force variation) applied by that finger is likely to be. This finding lends some support to the notion that the dominant pressure finger may also be the "steering" finger in the handwriting act. Yet, the direct relationship is demonstrated only with group means; there are many exceptions exhibited when pressures of individual Ss are examined. The true relationship between dominant pressure and "steering" finger might be gotten at by direct observation of the idiosyn-

TABLE VII

SUMMARY OF CATEGORIZATION OF SUBJECTS
BY GRADE LEVEL AND BY SEX
(See Text for Explanation)

Males					Females				
Level	High	Low	X	Σ	Level	High	Low	X	Σ
A	3	3	2	8	A	3	4	2	9
6	2	3	0	5	6	0	0	1	1
4	3	1	1	5	4	2	5	0	7
Σ	8	7	3	18	Σ	5	9	3	17

TABLE VIII

THE RELATIONSHIP BETWEEN FORCE VARIATION AND FINGER PRESSURE:
RANKING OF MEAN FORCE VARIATION AND MEAN FINGER PRESSURE

			Variation			Pressure		
Level	N	Pattern	T	M	I	T	M	I
	5	T M I	1.50(1)	1.44(2)	1.16(3)	6.60(1)	3.35(2)	1.65(3)
Adult	5	T I M	1.52(1)	1.12(3)	1.16(2)	3.75(1)	2.60(3)	3.20(2)
	7	I T M	1.57(2)	1.10(3)	2.00(1)	2.93(2)	1.75(3)	4.46(1)
	5	T M I	1.40(1)	1.24(2)	1.16(3)	6.40(1)	3.90(2)	2.60(3)
Grade 6	7	T I M	1.60(1)	1.10(3)	1.50(2)	5.40(1)	1.90(3)	3.10(2)
	1	I T M	1.50(2)	1.10(3)	1.60(1)	1.50(2)	1.00(3)	4.75(1)
	6	T M I	1.40(1)	1.20(2)	1.10(3)	5.80(1)	3.40(2)	2.20(3)
Grade 4	10	T I M	1.23(1)	1.13(3)	1.17(2)	4.40(1)	2.60(3)	3.30(2)
	4	I T M	1.30(1.5)	1.10(3)	1.30(1.5)	4.10(2)	2.90(3)	5.80(1)

cracies of individual grip patterns while the S is actually writing.

The overall conclusion appears to be that while handwriting is a highly personalized act, certain group tendencies can be identified in pressure phenomena. Future research ought to be concerned both with the idiosyncracies and the commonalities.

Summary

The present study was an extension of previous research in pressure phenomena in handwriting reported by Harris and Rarick. While the earlier studies were concerned primarily with point pressure, development of a grip transducer pen by the Parker Pen Company made feasible the measurement of grip pressure applied to the barrel of a writing instrument by electronic means.

The study was concerned with 1) the methodology of examining grip pressure phenomena, and 2) the examination of patterns and relationships that would facilitate the identification of pertinent questions for further study. The study, then, was primarily exploratory in orientation.

Absolute finger and point pressure and force variation were reported for the individual Ss studied and a number of group tendencies were identified. Implications for further study were pointed out.

FOOTNOTES

* Funds for the support of this study were provided in part by a grant from the Parker Pen Company, Janesville, Wisconsin, to the University of Wisconsin, and in part by a grant from the U. S. Office of Education.

** The study was conducted while Wayne Otto was a research assistant to the Committee for Research in Basic Skills—Virgil E. Herrick, Chairman; Theodore L. Harris, and G. Lawrence Rarick—the University of Wisconsin, Madison.

1. A technical description may be obtained from the Committee for Research in Basic Skills.

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A STUDY OF RELATIONSHIPS BETWEEN CHILD REARING ATTITUDES AND MATERNAL BEHAVIOR

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INASMUCH AS the literature is replete with studies concerned with the measurement of parental attitudes, there is little evidence concerning how these attitudes, as measured in the reported investigations, are related to the behavior of parents in interaction with their children. It is commonly assumed in these studies that measurements of parental attitudes yield important insights into existing parent-child relationships. The validity of such a concept, however, has not been established by empirical investigations. As Bell (1) points out, no studies directly concerned with the relation between parental attitudes and observed behavior of parents in interaction with their children have been reported in the literature. Such a study may aid psychologists and educators in reducing the complexity of problems involved in linking parents' attitudes to their actual behavior with their children, and may provide information on characteristics of parents which appear to affect the behavior of children.

The purpose of this investigation was to test the hypotheses that 1) maternal attitudes toward child rearing are significantly related to selected behaviors of mothers, observed in interaction with their children; 2) maternal behavior is independent of social class; 3) maternal behavior is independent of the sex of the child with whom the mother interacts.

Method

The subjects were 80 mothers together with one of their children. Forty of the mothers were classified as lower-class and the other 40 as middle-class, according to the McGuire-White (3) Index of Social Status (Short Form).

The 80 mothers meeting the following criteria, together with one of their children, served as subjects for the investigation: 1) white, 2) American born, 3) 20-40 years of age, 4) full-time homemakers with two or more children, and from intact families. Approximately one half of the mothers selected were observed with a male child and one half with a female child. The children ranged in age from two years and nine months to five years and one month.

Although more interaction occurs between mother and child in the home than in the laboratory, observations of mothers with their children, in this study, have been made in the laboratory setting in order to provide a control of the distracting stimuli present in homes. It was believed also that the presence of the observer in the home, where it would be difficult for him to remain unobtrusive, would influence the child's behavior to an even greater extent than would an unfamiliar setting (the laboratory) with his mother present.

The observations of middle-class mothers were conducted in the Child Development Laboratory at Texas Woman's University while the lower-class mothers were observed in the Child Study Laboratory at the Florida State University. Both laboratories had facilities for observing each mother together with her child through a one-way vision mirror and contained 1) various types of toys, 2) easel with paint, 3) books, 4) blocks, 5) small tables with chairs, and 6) a small kitchen unit consisting of sink, cupboard and stove.

Each mother-child pair was brought to the laboratory for one 30-minute period for the child to play while his mother stayed in the room with him. During this visit, the mother's interaction with her child was observed and recorded according to categories similar to those developed by Merrill (4), Bishop (2), and Schalock (6).

The symbols, categories, and definitions were:

(-) Being Uncooperative--e.g., Mother ignores the child's stimulation. Example: Mother continues to read magazine when child addresses her.

(c) Contacting--e.g., Mother is in contact with the child either verbally or physically. "Physically" means sitting or being near the child as he plays, even though she says nothing. "Verbally" means purely social conversation with the child. Example: "This is a nice doll-house. We'll see if daddy can build one for you like it."

(n) Criticizing--e.g., Mother criticizes, blames, or punishes the child. Example: "Now pay attention to what you are doing. You're pouring water all over the table."

(d) Directing--e.g., Mother specifically states the course of action which she wants the child to follow. Example: "Put the doll over there on the table." "I want you to close the door now, Johnny, not later."

(k) Giving Permission--e.g., Mother consents to child's proposed activity. Example: "Yes, you may use the towel."

(m) Giving Praise or Affection--e.g., Mother praises or gives encouragement to the child. This category also includes expressions of affection such as petting or hugging the child. Example: "That's a very fine boat you've made."

(h) Helping--e.g., Mother gives physical help to the child. Example: Mother pounds a nail for the child or replaces the mast and the sail belonging to the sailboat.

(i) Interfering--e.g., Mother interferes with an activity on the child's part with the intent of stopping it completely.
my boy--no more of that splashing." "No, Johnny, you are not to drink the water from those cups."

(si) Interfering by Structurizing--e.g., Mother indicates the undesirability of a certain action and/or the consequences of the act if carried out. Example: "You know other boys and girls will want to play with those toys and if you mash them together like that they will be spoiled."

(ƒ) Lending Cooperation--e.g., Mother responds to child's comments, suggestions, or requests with apparent interest and willingness. Example: "I would love to play house with you."

(a) Observing Attentively--e.g., Mother noticeably directs her attention to the child and/or child's activity by silently watching. Example: Mother watches child as the child plays with the stove.

(ρ) Playing Interactively--e.g., Mother is playing with the child within the framework of the child's own conception of play; she plays as though she were another child. Example: "I'll be the boat repair man and I'll fix the boat."

(z) Reassuring--e.g., Comfort or encouragement is offered by the mother. Example: "Don't feel too bad. Most children find it difficult to work that puzzle the first time."

(o) Remaining Out of Contact--e.g., Mother is sitting apart from the child, and is either reading magazines or looking away from the child. Example: Looking out of the window.

(r) Restricting--e.g., Mother modifies child's behavior by reducing intensity, speed, manner of executing, etc., but does not stop activity completely. Example: "Don't splash the water so high."

(s) Structurizing--e.g., Mother facilitates activity on the part of the child by methods which stimulate independent thinking and relegates the responsibility of decision to the child. Example: "Do you see something in this room out of which you could make a boat?"

(t) Teaching--e.g., Mother gives information to the child for the purpose of increasing his knowledge. Example: "This is a duck and that is a swan. Swans have longer, thinner necks than do ducks."

Reliability

Before observations were made for the purpose of data collection, it was necessary to achieve relatively high observer agreement with respect to the identification of the behavior under investigation, and their accurate placement within a given time interval.

Reliability was measured by calculating percentages of agreement between two observers recording maternal behavior simultaneously during thirty-minute periods. Middle- and lower-class mothers together with one of their children, who were not included in the study, served as subjects for establishing reliability. The observers became familiar with the definition of behavior categories, scoring system, and code letters. Categories were memorized and agreement reached concerning types of behavior defined by each of the categories.

Measures of agreement were obtained by comparing the observations of one observer with observations taken independently and simultaneously by another observer. These measurements of agreement may be obtained by (a) computing the percentages of agreement of the observers, or (b) correlating total scores obtained by two observers in successive periods of observation. The correlation method yields a spuriously high measure of reliability in that it measures only total agreement and not agreement on identical behavior categories within specific time intervals. For this reason, the percentage method has been utilized in this study.

In utilizing a predetermined system of categories, it is difficult to determine whether disagreement between simultaneous records is a function of placing the recorded observations in the appropriate time interval, or a function of difference in hearing and seeing in identifying the behavior. It is possible for two observers to see different interaction occurring at the same time, or to miss an event. This may be due to the position of the observers from which the interaction is viewed, or in recording the behavior (looking from the behavior to the stopwatch, to the obser-

vational sheet). Also disagreement may arise from differing interpretations of occurring interaction.

Factors such as the lack of satisfactory behavior definitions, misinterpretation of occurring behavior, and various recording methods of the observers are all factors which tend to create timing errors in the observation.

When timing errors are operating, the computation of observer agreement becomes difficult. It is impossible to determine errors or disagreements by inspection alone. If both observers have recorded the same behavior in adjacent time intervals, there is no assurance that the apparently disagreeing observations do not actually represent the same behavior. However, if both observers have the same entries in the same time interval, one cannot be certain that the agreement is not a spurious result of time differences, e.g., one can never be certain that agreeing observations do not actually represent different events. The only way by which the observation can be checked is by sound photography. Since the physical settings in which observational studies are ordinarily undertaken preclude the use of necessary equipment for sound photography and because the expense makes such a technique impractical, ratings of mother-child interaction were made according to predetermined categories following a training period during which two observers demonstrated their ability to observe and record reliably. When the observers achieved a competency in the recording of the behavior represented by agreement of .80 or higher between independent observations during at least five sessions, the collection of data for the project began.

It was recognized that while the child was unaware that he was being watched, the mother might feel keenly the presence of the observer and might modify her behavior in such a manner as to present a more favorable picture of the interaction between herself and child than actually exists in the home situation. Procedures for measuring the effect of the observers' presence on the mother's behavior are being studied by other investigators, but no conclusive evidence concerning this influence is currently available.

The mother was told to imagine the time spent in the laboratory as a half-hour in her own home, during which she is unoccupied by household duties and is free to be in the room where her child is playing. She was asked to act as she would if she were really in this situation. Questions were answered by stating that there was no particular way that she should act with the child and that she was free to do as she would do at home. Her behavior was rated and recorded under the appropriate category every five seconds. The observed behavior constituted the measure of the mother's behavior in interaction with her child.

The Attitude Instrument

In order to obtain measures of maternal attitudes, mothers were given the PARI developed by Schaefer and Bell (5). This measuring instrument was selected because it offers a variety of content, assesses a wide range of attitudes, and is one upon which information concerning reliability and validity is available.

During the visit to the laboratory, the PARI was administered to the mother by the investigator after the observation session, while the child, absorbed in his play, was supervised by a graduate assistant. The administration was by means of a structured interview in a room apart from the playroom.

The items utilized in the PARI were those appearing in 16 of the 23 subscales. It was felt, because the PARI measures attitudes toward child rearing and family life, that only subscales pertaining to child rearing would be used in this study. The remaining seven subscales were concerned with attitudes toward family life.

Results

Since the observations were made in two different laboratories, reliability was established for each laboratory prior to the collection of data. Disagreement most commonly evidenced by the observers was due to the placement of observed behavior in separate time intervals. This error was difficult to correct and most troublesome in establishing a satisfactory level of reliability.

The category reliabilities between the two observers expressed in terms of percent of their agreement concerning maternal behavior, based on ten 30-minute periods of observation, are presented in Table I. The percentages of agreement ranged from 81 to 100 percent.

Table II shows the frequency with which maternal behaviors in the laboratory appeared in each category. The categories of Contacting, Directing, Observing Attentively, Remaining Out of Contact, Structurizing, and Teaching constituted the major types of the mothers' behavior toward their children, while under observation. Although some mothers exhibited such behaviors as Being Uncooperative, Criticizing, and Helping, these behaviors generally had a low frequency of appearance.

Nine of the 17 behavior categories showed a significant relationship with social class at the .05 level or beyond when the median test was employed. Middle-class mothers evidenced more Contacting, Directing, Helping, Interfering by Structurizing, Observing Attentively, and Playing In-

TABLE I

RELIABILITIES OF MATERNAL BEHAVIOR CATEGORIES BASED ON TEN 30-MINUTE OBSERVATIONS

Category	Frequency	Percentage of Agreement Between Observers
Being Uncooperative	2	86
Contacting	1418	91
Criticizing	2	84
Directing	38	90
Giving Permission	12	100
Giving Praise or Affection	12	81
Helping	5	100
Interfering	10	96
Interfering by Structurizing	18	93
Lending Cooperation	17	94
Observing Attentively	1126	95
Playing Interactively	29	85
Reassuring	4	100
Remaining Out of Contact	824	93
Restricting	8	92
Structurizing	34	90
Teaching	41	85

TABLE II

FREQUENCY OF APPEARANCE IN THE LABORATORY OF CATEGORIZED MATERNAL BEHAVIOR

Behavior Category	Social Class	
	Middle (No. of) (N = 40)	Lower (No. of) (N = 40)
Being Uncooperative	6	2
Contacting	6420	2395**
Criticizing	10	3
Directing	920	141**
Giving Permission	30	2
Giving Praise or Affection	42	---
Helping	84	34*
Interfering	36	8
Interfering by Structurizing	92	11*
Lending Cooperation	170	35*
Observing Attentively	4688	2834*
Playing Interactively	202	7**
Reassuring	41	---
Remaining Out of Contact	1285	8616
Restricting	31	51
Structurizing	133	134
Teaching	210	127*

* Median Test value significant at the .05 level.
** Median Test value significant at the .01 level.

teractively than did lower-class mothers. However, lower-class mothers Remained Out of Contact more with their children than middle-class mothers. In general, the middle-class mothers interacted more with their children than did the lower-class mothers.

Behavior categorized as Being Uncooperative, Criticizing, Giving Permission, Interfering, Interfering by Structurizing, and Playing Interactively seldom appeared in the observation of lower-class mothers. Giving Praise or Affection and Reassuring were entirely lacking in the observed behavior of these mothers.

The significant relationships which appeared between the subjects' attitudes, as measured by the PARI, and their observed behavior toward their children are presented in Tables III and IV.

Of the 544 comparisons made by means of Spearman rank correlation coefficients computed between frequencies in the 17 maternal behavior categories and the 16 attitude subscales, 16 evidenced significant relationships at the .05 level or beyond. Relationships are suggested by the significant values of the correlation coefficients between attitude subscales and behavior categories:

Attitude Subscales	Behavior Categories
Approval of Activity	Contacting, Observing Attentively
Avoidance of Communication	Restricting, Remaining Out of Contact
Breaking the Will	Directing, Restricting
Comradeship and Sharing	Helping, Teaching
Encouraging Verbalization	Contacting, Helping, Lending Cooperation
Equalitarianism	Contacting, Helping, Teaching

Inasmuch as one might expect, by chance, to observe values which attained significance at the .05 level approximately five times out of 100 when no real relationship exists, it would appear that interpretation of these statistical relationships should be undertaken with caution.

Middle-class mothers evidenced 12 relationships between the attitude subscales and behavior categories while lower-class mothers only four. It is possible that lower-class mothers were shy and would not interact more freely with their children as compared with middle-class mothers. However, it is not unlikely that in the home setting the middle- and lower-class mothers might have evidenced more Being Uncooperative, Criticizing, Interfering, and Restricting behavior, for example, than she did in the laboratory setting because of her desire to appear as a "good mother" while being observed by the experimenter. It is recognized, however, that the lack of apparent relationships may, in many instances, be a function of the setting in which the observations were made.

The frequencies of the various types of maternal contacts with sons and daughters are presented in Tables V and VI. Of the 17 behavior categories, only five showed a significant relationship with the sex of the child at the .05 level, when the median test was employed.

Two behavior categories showed a significant relationship with the sex of the child between the middle-class mothers and their children. The mothers of daughters evidenced more Contacting than did mothers of sons. However, mothers of sons showed more Observing Attentively behavior than did mothers with daughters.

Three behavior categories evidenced a significant relationship between lower-class mothers and their children. The mothers of sons showed more Restricting behavior than did mothers with daughters. However, the mothers of daughters evidenced more Contacting and Structurizing than did mothers of sons.

Discussion

The lack of statistically significant relationships observed between maternal attitudes toward children and most of the selected behavior of mothers in an unstructured laboratory setting suggests several hypotheses, e.g., the mothers' behavior evidenced in a laboratory setting may not have been representative of their behavior under home conditions. Since the mother knew that an observer was present, she may have evidenced more socially acceptable behaviors than is usual in the home situation.

If the experimenter obtained a reasonably close approximation of customary mother-child relationships, however, the findings suggest that maternal behavior cannot be predicted from an analysis of maternal attitudes toward children. If the mothers displayed a more socially acceptable type of interaction with the child in the laboratory than is habitual in the home, it could not be ascertained whether such behavior played a predominant role in their relationship or whether it was merely conditioned by the presence of the observer.

Since the middle-class mothers interacted more with their children, the lower-class mothers may have exhibited shyness or reticence in a totally unfamiliar situation. This is suggested by

TABLE III

CORRELATION VALUES BETWEEN MATERNAL ATTITUDE SCORES AND OBSERVED BEHAVIOR RATINGS OF MIDDLE-CLASS MOTHERS

Attitude Subscales	Behavior Categories					
	Contacting	Directing	Helping	Observing Attentively	Remaining Out of Contact	Teaching
Approval of Activity	.34*			.46*		
Avoidance o Communication					.46**	
Breaking the Will		.35*				
Comradeship and Sharing			.32*			.36*
Encouraging Verbalization	.34*		.36*			.37*
Equalitarianism	.32*		.36*			.34*

* Significant at .05 level. ** Significant at the .01 level.

TABLE IV

CORRELATION VALUES BETWEEN MATERNAL ATTITUDE SCORES AND OBSERVED BEHAVIOR RATINGS OF LOWER-CLASS MOTHERS

Attitude Subscales	Behavior Categories			
	Directing	Lending Cooperation		Restricting
Avoidance of Communication	.34*			.46**
Breaking the Will	.34*			.46**
Encouraging Verbalization		.36*		

* Significant at .05 level ** Significant at .01 level.

TABLE V

FREQUENCY OF MATERNAL CONTACTS OF MIDDLE-CLASS MOTHERS WITH SONS AND DAUGHTERS

Behavior Categories	Mothers' Interaction with	
	Sons	Daughters
Being Uncooperative	4	2
Contacting	2962	3458*
Criticizing	7	3
Directing	419	501
Giving Permission	17	13
Giving Praise or Affection	23	19
Helping	37	47
Interfering	21	15
Interfering by Structurizing	39	53
Lending Cooperation	81	89
Observing Attentively	2989	1699*
Playing Interactively	103	99
Reassuring	27	14
Remaining Out of Contact	605	683
Restricting	19	12
Structurizing	61	72
Teaching	93	117

* Median Test value significant at the .05 level.

TABLE VI

FREQUENCY OF MATERNAL CONTACTS OF LOWER-CLASS MOTHERS WITH SONS AND DAUGHTERS

Behavior Categories	Mothers' Interaction with	
	Sons	Daughters
Being Uncooperative	1	1
Contacting	949	1446*
Criticizing	2	1
Directing	60	81
Giving Permission	---	2
Giving Praise or Affection	---	---
Helping	15	19
Interfering	4	4
Interfering by Structurizing	6	5
Lending Cooperation	18	17
Observing Attentively	1500	1334
Playing Interactively	3	4
Reassuring	---	---
Remaining Out of Contact	4528	4088
Restricting	29	22*
Structurizing	50	84*
Teaching	57	70

* Median Test value significant at the .05 level.

the low frequency of both positive and negative behaviors, e.g., Being Uncooperative, Criticizing, Directing, Giving Praise or Affection, Helping, Interfering, Interfering by Structurizing, Lending Cooperation, Playing Interactively, Reassuring, Restricting, Structurizing, and Teaching. Schalock (6) states that a mother and child spend a large proportion of the time in Non-Attendance and that the interaction which occurs most frequently on the part of the mother is Attendant Observation, Statement of Condition or Action, Seeking Impersonal Information, Offering Verbal Information, Directing, and Joint Participation in Activity. In the present study, these behaviors make up approximately 80 percent of the lower-class mother's interaction and 90 percent of the middle-class mother's interaction.

It would be logical to assume that middle-class mothers who had children enrolled in nursery school would have a tendency to evidence less shyness or reticence and would interact more freely with their children than would mothers whose children did not attend nursery school, since mothers of nursery school children are exposed to a parent education program aimed toward increasing understanding of children and improving parent-child communication.

The data in the present study suggest several hypotheses worthy of further investigation:

In guiding their children, lower-class mothers less frequently than middle-class mothers:

(a) impose techniques of suggesting, teaching, and helping in their interaction with their children.
(b) interact with their children.

In guiding their children, lower-class mot ers more frequently than middle-class mothers:

(a) evidence more structurizing behavior with girls than with boys.
(b) are more restrictive with boys than with girls.

Both middle-class and lower-class mothers more often approve than disapprove:

(a) comradship sharing between parents and their children.
(b) loyalty to parents.
(c) encouraging children to verbalize about their feelings without fear of reprimand.
(d) equalitarianism between parents and children.

Although it is apparent that there are limitations inherent in the type of observational methodology as described in the study reported, e.g., length of time required to train observers, the effect of the observer on the interaction of the subjects, such a method has several advantages when compared to others which are frequently utilized in studies of family interaction. Studies which have employed such techniques as rating scales, questionnaires, and interviews have placed, in the investigator's opinion, undue reliance upon the respondents' evaluation of the kind of interaction occurring within the family and have failed to obtain the kind of precise information which direct observation yields. Thus, the literature is replete with studies of relationships which are based upon subjective judgments of individuals who, it is generally recognized, not infrequently yield a less self-incriminating measure than would have been obtained by a trained, objective observer.

The advantage of recording behavior at the moment of occurrence in terms of yielding precise statements is obvious, yet relatively few studies have been undertaken using members of the same family in which their behavior has been rated according to predetermined categories and rated at the time of occurrence. Admittedly, such a technique is expensive in terms of the time required for the data collection. However, until such studies are undertaken in order to determine the behaviors employed by family members in their interaction with others, many of the conclusions of investigators of family behavior who have made use of the traditional questionnaire, rating scale, and interview, must be considered tentative.

Summary

This investigation sought to test the hypothesis that 1) maternal attitudes toward children are significantly related to selected behaviors of mothers, observed in interaction with their children; 2) maternal behavior is independent of social class; and 3) maternal behavior is independent of the sex of the child with whom the mother interacts.

The categories of Contacting, Directing, Observing Attentively, Remaining Out of Contact, Structurizing, and Teaching constituted the major types of the mothers' behavior toward their children, while under observation. Middle-class mothers evidenced more Contacting, Directing, Helping, Interfering by Structurizing, Observing Attentively, and Playing Interactively than did lower-class mothers. Lower-class mothers Remained Out of Contact more with their children than did middle-class mothers. In general, the middle-class mothers interacted more with their children than did lower-class mothers.

Of the 544 comparisons made by means of Spearman rank correlation coefficients computed between frequencies in the 17 maternal behavior categories and the 16 attitude subscales, 16 evidenced significant relationships at the .05 level or beyond. Middle-class mothers evidenced twelve relationships between the attitude subscales

and behavior categories while lower-class mothers only four.

Of the 17 behavior categories, only five showed a significant relationship with the sex of the child at the .05 level when the median test was applied between frequencies of maternal contacts with sons and daughters.

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THE DEVELOPMENT OF A FIRST GRADE ADJUSTMENT SCALE

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THE PURPOSE of the present paper is to describe the development of a rating scale designed to assess the young child's adjustment in first grade. Although several elementary school behavior rating scales are available (1, 2), none applies specifically to the child's adjustment to the demands of the educational regime in the first grade.

The development of the present scale was dictated by the requirements of a larger study dealing with readiness for first grade and first-grade adjustment. The investigation was a short-term longitudinal one in which a group of five-year-olds were studied throughout the year prior to their entrance into first grade. The group was followed into the first grade where data related to achievement and adjustment were collected. Since one of the purposes of the study was to establish relationships between the skills, abilities, and attitudes which the child brings to the first-grade situation and the classroom teacher's evaluation of his overall adjustment and achievement in the first grade, some criterion measure of adjustment upon which the subjects could be rated was necessary. In addition, such a scale would seem desirable in view of the importance and concern which both parents and educators attach to the child's ability to adjust to the initial experience of formal schooling. While little information is available in the research literature concerning the relation between early school adjustment and adjustment in later school years, there are indications of at least a moderate degree of consistency in individuals' adjustment over varying time periods.

Procedure

Method

The following procedure was employed in the construction of the scale. Twenty-five first-grade teachers of a large metropolitan school system were interviewed individually concerning the factors related to a child's adjustment in grade one. The years of classroom experience of the teachers interviewed ranged from three to thirty-nine with a median of approximately fifteen years. The teachers were asked to mention specific traits, abilities, and items of behavior which, in their opinions, characterize or describe good adjustment and poor adjustment in the first grade. The data pertaining to good adjustment and poor adjustment were itemized separately. Each item was tabulated and its frequency of mention recorded. A preliminary grouping was made in those instances in which the trait names or behavior adjectives were overlapping or relatively synonymous; for example, "reliable" and "dependable" were grouped together. The characteristics listed for good and poor adjustment were then examined for parallel items which seemed to define opposite ends of a single continuum. It was interesting to note that for a majority of the behavior items mentioned for good adjustment, comparable characteristics were listed to describe poor adjustment. The parallel items for which there was at least a minimum level of consensus were placed on a five-point scale with "3" representing the midpoint, or rating of the "average" child, and "1" and "5" describing poor and good adjustment, respectively. Brief descriptive phrases, taken largely from the teacher interviews, were provided for the end points. The items were grouped into five major areas: I. Physical Status and Motor Behavior, II. Social Behavior, III. Emotional Behavior, IV. Intellectual Abilities and Behavior, and V. Adjustment to Classroom Membership and Requirements. The adjustment scale together with the directions for rating appear below. To conserve space, only the end points, "1" and "5", are listed. In the scale manual itself each scale item is diagrammed on a horizontal line with "1" and "5" appearing at opposite ends of the line, and the numbers "2", "3", and "4" equally spaced along the line. Separate rating sheets are provided, with spaces opposite each trait for the appropriate number.

*This research was completed under the sponsorship of the Elizabeth McCormick Memorial Fund of Chicago.

FIRST-GRADE ADJUSTMENT SCALE

Directions for Rating:

Please read carefully the descriptive phrases which appear at either end of each trait scale. These phrases define the traits and are to be considered as anchor points. It should be noted that in every case the left end describes the positive or desirable aspect of a trait while the opposite is true of the right end. Each trait should be thought of, then, as existing on a continuum from positive to negative. The center of each scale, "3", indicates the position in which the "average" child would be placed with regard to a trait.

In making your decision concerning the rating to be given, freely compare the child with other children of his age level on a particular dimension. Consider only one trait at a time. In this way a generally favorable or unfavorable impression which you may hold of a child will not influence your objective rating of him on each scale. Although occasionally you may feel that the child is best described by a point lying between two numbers, please select one of the numbers.

After selecting one number as a rating, write that number on the separate blank provided opposite the appropriate item number. Please do not write on the rating scale itself.

I. Physical Status and Motor Behavior

1. Physical condition and health
   1 - Weak physical system; poor health; tires easily
   5 - Excellent physical condition; healthy

2. Physical coordination (gross muscle coordination)
   1 - Poor physical coordination; awkward
   5 - Excellent physical coordination; agile

3. Muscular control (fine muscle coordination)
   1 - Poor muscular control—as in drawing, coloring
   5 - Excellent muscular control—e.g., in holding crayon, chalk

4. Ability to dress self
   1 - Unable to dress self
   5 - Very capable of dressing self; can tie shoestrings

II. Social Behavior

1. Leadership
   1 - Is lacking in leadership qualities
   5 - Possesses good leadership qualities

2. Relationship with other children
   1 - Doen't get along well with other children; quarrels; fights; bullies; has few playmates
   5 - Gets along well with other children; has many playmates; is well liked

3. Friendliness to other children
   1 - Unfriendly to other children; hostile
   5 - Shows open friendliness to other children

4. Sympathy
   1 - Unsympathetic; indifferent
   5 - Sympathetic to others' problems; compassionate

5. Consideration for others
   1 - Inconsiderate; self-centered
   5 - Considerate; thinks of others; respects abilities and opinions of others

6. Sense of fair play
   1 - Lacks a sense of fair play
   5 - Strong sense of fair play; abides by peer group rules and requirements

7. Willingness to share
   1 - Unwilling to share; hasn't learned to share
   5 - Always willing to share

8. Willingness to take turns
   1 - Unwilling to take turns; impatient in waiting
   5 - Always willing to take turns; waits patiently for a turn

9. Ability to play in a large group
   1 - Doesn't know how or is unable to play in a large group
   5 - Is able to play in a large group

10. Defensiveness
    1 - Defensiveness—every little hit demands a full battle
    5 - Doesn't have to fight back if pushed or hit; able to accept taunts

11. Self-assertiveness
    1 - Takes a back seat; passive; can be led
    5 - Sticks up for self; doesn't let others run over him

12. Outgoingness
    1 - Shy; bashful; timid; initiates few contacts with other children
    5 - Outgoing; initiates many contacts with other children

13. Tendency to tattle
    1 - Frequently tattles on other children
    5 - Is not a tattle-tale

14. Social independence
    1 - Socially dependent; disturbs other children; handles, touches them; pokes others
    5 - Socially independent and self-sufficient; doesn't touch or feel other children

III. Emotional Behavior

1. Happiness, cheerfulness
    1 - Unhappy, gloomy disposition; whiny; pouts
    5 - Happy, cheerful

2. Reaction to praise and criticism
    1 - Resents correction or criticism; overreacts to praise
    5 - Takes praise and criticism in stride

3. Fears and anxieties
    1 - Has many fears and anxieties
    5 - Free of fears and anxieties

4. Flexibility
    1 - Inflexible–gets upset over a change in the pattern of activities
    5 - Flexible–if doesn't get own way, can modify behavior; doesn't get upset over a change in routine
5. Reaction to failure
    1 - Unable to face failure; reacts to failure with discouragement and irritability
    5 - Courageous, perseveres in face of failure
6. Emotional maturity
    1 - Immature, cries easily; easily upset; lacks self-control; babyish
    5 - Emotionally mature; stable; possesses self-control

7. Degree of tension
    1 - Tense; nervous
    5 - Relaxed

8. Initial adjustment to school situation
    1 - Initial fear of school; took a long time to adjust to the school situation
    5 - Adjusted readily to school; inapprehensive of school situation

9. Sense of humor
    1 - Lacks a sense of humor
    5 - Possesses an excellent sense of humor

10. Self-confidence
    1 - Lacks self-confidence
    5 - Self-confident; self-assured

IV. Intellectual Abilities and Behavior

1. Language development
    1 - Immature language development; unable to express self adequately; poor vocabulary
    5 - Mature language development; able to talk in simple, accurate sentences, large vocabulary for age level

2. Creativity, originality
    1 - Few original ideas; unimaginative
    5 - Very creative; much originality, excellent imagination

3. Background knowledge and information
    1 - Possesses little or inadequate background information
    5 - Possesses much background knowledge and information

4. Curiosity
    1 - Little curiosity; fails to explore, investigate
    5 - Is keenly curious

5. Evaluation of own abilities and achievement
    1 - Incorrect view of ability; either over- or under-estimates ability
    5 - Realizes own capacities and is satisfied; able to evaluate own achievement

6. Eagerness to learn
    1 - Lacks drive; no spark; lacks initiative to learn
    5 - Eager to learn; drive; initiative to work out own ideas

7. Speed of comprehension
    1 - Slow in understanding new ideas and new material
    5 - Catches onto things quickly; grasps ideas without difficulty

V. Adjustment to Classroom Membership and Requirements

1. Ability to listen
    1 - Inattentive; dreamer; in a world of his own
    5 - Is a good listener; gives rapt attention

2. Cooperativeness
    1 - Uncooperative; hinders group activities
    5 - Cooperates well in organized group activities and functions

3. Ability to follow directions
    1 - Doesn't follow directions
    5 - Follows directions well

4. Use of extra time
    1 - Poor use of extra time; wastes time
    5 - Uses extra time well; never lacks for

something to do; always busy

5. Acceptance of school rules
   1 - Doesn't follow rules; resents them
   5 - Accepts and obeys school rules and regulations

6. Ability to work independently
   1 - Can't work independently
   5 - Independent; can work independently

7. Attention span
   1 - Short attention span
   5 - Excellent attention span

8. Interest in classroom activities
   1 - No interest in school nor its activities
   5 - Great interest in classroom activities

9. Distractibility
   1 - Restless; can't settle down; needs very varied activities
   5 - Able to work quietly for an adequate period of time without becoming restless

10. Contributions to group
    1 - Contributes little meaningful information to group discussions
    5 - Makes worthwhile contributions to group discussions

11. Care of own equipment
    1 - Unable to take care of personal equipment; misuses it
    5 - Competent in care of own equipment—e. g., crayons

12. Work habits
    1 - Doesn't know what to do next; doesn't get work done; messy; careless
    5 - Knows what to do at the right time; completes assigned work; cleans up own space

13. Attitude toward work
    1 - Lazy; does work poorly; complains about work to be done; doesn't want to work—would rather play with toys
    5 - Accepts the job to be done; works hard; takes pride in his work

14. Persistence
    1 - Lacks persistence
    5 - Always persistent

15. Reliability, dependability
    1 - Unreliable; undependable; can't be counted on to carry out assigned responsibilities
    5 - Reliable; dependable; sense of responsibility; able to take responsibility in the room

16. Acceptance of role as group member
    1 - Displays continual attention-getting behavior
    5 - Fits into classroom affairs without demanding undue attention from teacher or from peers

17. Sense of responsibility to group and to teacher
    1 - No sense of responsibility to group or to teacher
    5 - Strong sense of responsibility to group and to teacher

18. Attitude toward school property
    1 - Destructive of school property and equipment
    5 - Strong sense of responsibility towards school materials and property

19. Acceptance of teacher's role
    1 - Rebellious against authority; defiant
    5 - Accepts teacher's (authority) role

Inter-rater reliability coefficients were obtained for the five sections of the scale and for the full scale from the ratings of one first-grade class consisting of twenty-five children by two practice teachers in the University of Minnesota Elementary School. The teachers had had three months of practice teaching experience with the group. This original group of children is labeled the "pilot group" to distinguish it from the "study group" of first graders for whom the adjustment scale was designed.

Description of Subjects

The adjustment scale was used to rate the subjects in the larger study dealing with first-grade readiness and adjustment. A brief description of these children will be given. The location of the field study was a small midwestern community of approximately 5000 residents. None of the subjects had had previous kindergarten experience. Thirty-five first graders, 19 boys and 16 girls, comprised the study group. The mean I. Q. of the group was 111. 6 according to the Stanford-Binet (Form L) intelligence test administered by the investigator. The socio-economic status of the children's families was approximately evenly divided between the upper-lower and lower-middle classes according to Warner's Index of Status Characteristics (3). Twenty-five of the subjects comprised one first-grade classroom. The remaining ten subjects were members of another first-grade section.

Analysis of the Data

The adjustment ratings were made by the

classroom teacher during the last month of the first-grade year. The adjustment scores were analyzed in relation to the C. A. 's and I. Q. 's of the subjects. The difference in the mean adjustment scores of the boys and girls was tested for significance. In addition, the scores of the pilot group were related to ratings on the Haggerty-Olson-Wickman Behavior Rating Schedules made in the kindergarten year.

Results

Table I lists the inter-rater reliability coefficients which were obtained.

TABLE I

INTER-RATER RELIABILITY COEFFICIENTS

Adjustment Scale Sub-areas	r
I. Physical Status	.70
II. Social Behavior	.70
III. Emotional Behavior	.72
IV. Intellectual Abilities	.78
V. Adjustment Classroom Requirements	.78
Full scale	.77

A product-moment correlation coefficient of -.52 was obtained between the first-grade adjustment ratings of the pilot group and their Haggerty-Olson-Wickman ratings made in the kindergarten year. The correlation is in the expected direction since, in contrast to the First Grade Adjustment Scale scores, the higher Haggerty-Olson-Wickman scores indicate poor adjustment.

The correlations computed between adjustment scores and C. A. and I. Q. for the study group were +.21 and +.42, respectively. The respective mean ratings of the boys and girls were 168. 72 and 183. 35; the range of the scores for the group was from 74 to 253. The obtained t for the significance of the difference between unrelated means for the sex difference was not statistically significant.

Discussion

While not as high as might be desired, the inter-rater reliability coefficients were of such a magnitude as to indicate at least a moderate amount of agreement in the way in which two teachers view the specific behaviors of a group of first-grade children. Longer association with the children by the practice teachers might well have led to higher coefficients.

The correlation between the first-grade adjustment ratings of the pilot group and their Haggerty-Olson-Wickman ratings made in the kindergarten year indicate a fair agreement between these two measures, especially in view of the fact that the two ratings were made by different raters and were separated in time by nearly a year. Thus, the present scale is substantially related to a known measure of adjustement.

While the correlation between I. Q. and the adjustment ratings suggests that intelligence plays a significant part in the child's adjustment, it is apparent that intelligence alone does not account for a great deal of the variance in the adjustment scores. One might speculate, certainly, concerning the importance of general emotional maturity, drive for achievement, and so forth.

While the mean rating of the boys was below that of the girls, the difference was not statistically significant. This is somewhat contrary to expectation since more boys than girls are often identified as poorly adjusted by the classroom teacher. In an attempt to examine the data more closely in this regard, the differences in the mean ratings of the boys and girls for the five sub-areas were tested for significance. Again, none of the t's were statistically significant, although the greatest difference was obtained for the area, Adjustment to Classroom Membership and Requirements. This would seem in line with the notion that boys experience more difficulty than girls in adjusting to classroom routine and to the activities which comprise the school situation.

Several advantages of the scale might be mentioned. First, the adjectives describing the end points of each scale are not so extreme that a rater would hesitate to assign a child such a rating. Second, the language and terminology employed is understandable and meaningful to teachers since for the most part the items are phrased in words actually used by first-grade teachers. And, third, first-grade children can be rated without difficulty on all of the items; this stems again from the fact that the items included in the rating scale emerged from discussions with first-grade teachers.

The First Grade Adjustment Scale would be of value to the first-grade teacher as a guide in conferences with parents, especially in the conference held at the end of the year. The scale would be helpful in pinpointing general as well as specific areas of weaknesses and strengths. Also, as employed in the larger study of first-grade adjustment, the scale is useful in a number of research areas.

Summary and Conclusions

The present paper described the construction of a First Grade Adjustment Scale. The scale consists of 52 items of behavior, grouped into five major areas, obtained from interviews with 25

first-grade teachers.

The scale was used for rating two groups of first graders, a pilot group and a study group, to obtain reliability and other data. The children's scores on the scale were examined in relation to C. A., I. Q., and sex differences.

The following results emerged from the study:

1. The inter-rater reliability of the full scale was . 77.
2. A correlation coefficient of -. 52 was obtained between the first-grade adjustment ratings of the pilot group and their Haggerty-Olson-Wickman ratings made in the kindergarten year; this was in the expected direction.
3. Coefficients of +. 21 and +. 42 were obtained between the adjustment scores and C. A. and I. Q. respectively, for the study group.
4. The respective mean ratings of the boys and girls were 168. 72 and 183. 35.

Several uses of the scale for the classroom teacher and the researcher were discussed.

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A STUDY OF ACHIEVEMENT AS A FUNCTION OF HOMOGENEOUS GROUPING

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FOR MANY years, our public schools have recognized that pupils have a wide range of abilities, interests, and degrees of motivation. In order to provide for these individual differences, many schools have grouped their classes homogeneously.

Early attempts at class grouping were executed with no empirical proof of its efficacy; and even today, there is inconclusive evidence as to the instructional value of homogeneous grouping.

Approximately 25 years ago, it was reported that the literature related to homogeneous grouping had been carefully reviewed, and the most significant conclusion from it all was how little it had "brought of clearly incontestable knowledge" (3). Professor Passow, in 1956, stated that there was no "significant unanimity of findings" in this area (2). One critical evaluation and synthesis of the research indicated that the evidence slightly favored homogeneous grouping where adaptation of teaching methods had accompanied it. But there is inadequate evidence as to the proper adaptations (1).

Purpose and Procedure

The purpose of this study was to test the null hypothesis that children grouped homogeneously by subject matter achievement, and who were given instructional materials on their achievement level, would show no greater achievement as a result than pupils who were grouped heterogeneously and followed a regular course of study.

During the 1959-1960 school session, pupils in five fourth-grade classes at Deep Creek Elementary School participated in the study as experimental subjects. Control subjects were selected from the fourth grades of two other Norfolk County Schools.

At the close of the third grade, experimental and control pupils were given the Iowa Tests of Basic Skills. Grouping of experimental classes for fourth-grade study was effected through the use of scores from this test. Homogeneous groups were formed in three areas: arithmetic, language, and reading. All experimental pupils were listed in rank order in terms of their grade equivalent scores. The members of a class were chosen then by selecting the top 20 percent, the second 20 percent, and so on. Pupils were placed in arithmetic class on the basis of their arithmetic scores, in language class on the basis of their language scores, and in reading class on the basis of their reading scores. Some pupils who were in the highest reading class were only average in arithmetic; therefore, they would be in a lower arithmetic class. As a result, it was necessary for these pupils to change classes for study in the three areas mentioned. For study in areas other than arithmetic, language, and reading, the groups remained intact and did not change classes.

At the beginning of the fourth grade, it was found that one experimental class, on the average, was achieving at the fifth-grade level; therefore, fifth-grade materials were provided. Two classes were given fourth-grade materials and two classes were given third-grade materials because of their levels of achievement.

Control pupils were matched with experimental pupils in each of the three areas. The comparability of these two groups in terms of achievement at the beginning of the experiment may be seen from an inspection of Tables I, II, and III.

Schools in which control pupils were enrolled had no knowledge that the experiment was being conducted. Control pupils were grouped heterogeneously, and all of them followed the usual course of study with fourth-grade materials being provided.

Achievement of the experimental and control groups was measured at the close of the fourth grade with the Iowa Tests of Basic Skills.

Analysis of Results

The analysis of data was accomplished by a treatment by levels analysis of variance design. By constituting different levels in the analysis, it was possible to determine if any interaction

TABLE I

BEGINNING MEAN GRADE EQUIVALENTS-ARITHMETIC

	Grade Equivalent Range	Experimental Mean	Control Mean
Level 1	4.6 - 5.4	4.96	5.00
Level 2	4.2 - 4.6	4.43	4.39
Level 3	3.6 - 4.2	3.93	3.93
Level 4	2.3 - 3.6	3.10	3.16
Total	2.3 - 5.4	4.11	4.12

TABLE II

BEGINNING MEAN GRADE EQUIVALENTS-LANGUAGE

	Grade Equivalent Range	Experimental Mean	Control Mean
Level 1	4.5 - 7.0	5.15	5.15
Level 2	3.9 - 4.5	4.21	4.20
Level 3	3.5 - 3.9	3.69	3.70
Level 4	1.8 - 3.3	3.00	3.04
Total	1.8 - 7.0	4.01	4.02

TABLE III

BEGINNING MEAN GRADE EQUIVALENTS-READING

	Grade Equivalent Range	Experimental Mean	Control Mean
Level 1	4.6 - 6.9	5.53	5.52
Level 2	3.8 - 4.6	4.20	4.19
Level 3	3.2 - 3.8	3.50	3.52
Level 4	2.3 - 3.2	2.89	2.89
Total	2.3 - 6.9	4.03	4.03

TABLE IV

FINAL MEAN READING GRADE EQUIVALENTS

	N per Cell	Experimental Mean	Control Mean	Difference Between Means
Level 1	27	6.17	6.36	.19
Level 2	27	5.28	5.75	.47
Level 3	27	4.57	4.95	.38
Level 4	27	3.94	4.57	.63
Total	108	4.99	5.41	.42

TABLE V

SUMMARY TABLE - READING

Source	df	SS	MS	F
A	1	9.54	9.54	10.36*
L	3	124.97	41.65	45.27*
AL	3	1.41	.47	.51
w cells	208	191.64	.92	
Total	215	327.56		

* Significant at the .01 level of confidence.

TABLE VI

FINAL MEAN ARITHMETIC GRADE EQUIVALENTS

	N per Cell	Experimental Mean	Control Mean	Differences Between Means
Level 1	24	5.66	5.95	.29
Level 2	24	5.29	5.40	.11
Level 3	24	4.95	5.24	.29
Level 4	24	4.02	4.50	.48
Total	96	4.98	5.27	.29

TABLE VII

SUMMARY TABLE - ARITHMETIC

Source	df	SS	MS	F
A	1	4.14	4.14	11.18*
L	3	60.94	20.31	54.89*
AL	3	.82	.27	.72
w cells	184	67.82	.37	
Total	191	133.72		

* Significant at the .01 level of confidence

TABLE VIII

FINAL MEAN LAUGUAGE GRADE EQUIVALENTS

	N per Cell	Experimental Mean	Control Mean	Difference Between Means
Level 1	29	6.79	6.67	.12
Level 2	29	5.49	5.65	.16
Level 3	29	4.90	5.23	.33
Level 4	29	4.36	4.48	.12
Total	116	5.39	5.51	.12

TABLE IX

SUMMARY TABLE - LANGUAGE

Source	df	SS	MS	F
A	1	.84	.84	1.00
L	3	166.18	55.39	65.94*
AL	3	1.53	.51	.60
w cells	224	188.71	.84	
Total	231	357.26		

* Significant at the .01 level of confidence.

were present. Or, in other words, did the experimental treatment produce an effect at one level of achievement but not at the others? To illustrate further, perhaps the experimental treatment had a positive effect on the low and high achievers but not on the average achievers.

Table IV on the next page shows the final mean grade equivalents achieved by the experimental and control groups in reading.

It is apparent from Table IV that the control group's final reading achievement was higher than that of the experimental group. Over all, there was a difference in achievement of approximately four months between the two groups. Also, the difference was in favor of the control group at all levels. The question to be answered is whether the differences between the groups are statistically significant. The data in Table V, next page, presents in summary form the analysis of variance which answers this question.

"A" in Table V represents the treatment groups, i.e., experimental and control, and the variance for A was significant at the .01 level. This suggests the probability is only one in a hundred that the total difference between these two groups is due to chance.

"L" represents the level of achievement. The information in Table V indicates that there was a significant difference between the means (which includes both the experimental and the control scores) of the levels. It is to be expected that the variance would be significant here.

"AL" denotes the treatment by level interaction. The variance for this category is not significant. Therefore, we must accept the hypothesis that no interaction is present. This is to say that the two treatments did not have significantly different effects at the different levels of achievement. In other words, the groups reacted essentially the same at each level.

Table VI presents the final mean grade equivalents for arithmetic. Higher arithmetic achievement was made by the control group at all levels, as revealed in this Table. Overall, there were approximately three months' difference in favor of the control group. The information in Table VII is a summary of the analysis of variance for these data.

"A" in Table VII represents the treatment groups and the variance here is significant at the .01 level of confidence. Again, this indicates that there is only one possibility in a hundred that the total mean difference between the two groups could be due to chance.

"AL" represents the treatment by levels. The variance for this category is not significant. Again, this suggests that there was no significant difference in the way the groups reacted at the different levels.

Table VIII shows the final mean achievement in language. The control group's total mean grade equivalent exceeded that of the experimental group by approximately one month. At Level 1, the experimental group's mean was roughly one month higher than that of the control. Table IX presents the analysis of variance of these data.

The variance for A in Table IX indicates that the total difference between the two groups was not statistically significant. The AL variance is also non-significant. Therefore, we may conclude that there were no real differences in the language achievement of the two groups.

Summary and Conclusions

The purpose of this experiment was to test the null hypothesis that fourth-grade pupils grouped homogeneously by subject matter achievement, and who were given materials and instruction on their achievement level, would show no greater achievement than pupils who were grouped heterogeneously and who used only fourth-grade materials. On the basis of the evidence gathered in this study, this hypothesis cannot be rejected. Here, too, as in many other studies, homogeneous grouping failed to realize its theoretical possibilities.

Experimental and control pupils were closely matched in terms of achievement at the beginning of the experiment. However, it may be that many variables that need to be controlled in experimentation with human behavior evaded control in this study.

The theoretical possibility still exists that educational experiences can be made more pointed and more meaningful when teachers can plan them for a class with a narrower range of differences; but in order to resolve this question, further experimental evidence is necessary.

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THE INFLUENCE OF MENTAL ABILITY ON ACHIEVEMENT WHEN SOCIO-ECONOMIC STATUS IS CONTROLLED

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BOTH MENTAL ability and socio-economic status have been found to correlate moderately with criteria of academic achievement (Lennon and Schutz, 2; Warner, Meeker, and Eells, 5). Unfortunately, the interpretation of these findings is complicated by the correlation of similar magnitude between mental ability and socio-economic status (Knief and Stroud, 1). McClelland (3) has attempted to account for this triangle of relationships by suggesting that mental ability may function as a "threshold" type variable with respect to academic achievement. That is, a certain minimal level of mental ability may be required to achieve in school. Beyond this point, however, the obtained correlation between intelligence and achievement may be due to uncontrolled variability on factors such as socio-economic status. Consistent with this hypothesis is Terman and Oden's (4) finding that, given a high level of intelligence, successful and unsuccessful individuals differ primarily in terms of socio-economic factors.

The present study was an attempt to determine whether mental ability exerts an influence on school performance irrespective of socio-economic status. Specifically, the study tested the hypothesis that the academic achievement of pupils with "average" and "high" mental ability does not differ significantly when socio-economic status is controlled.

Sample

All Ss were selected from a single elementary school district. The district is located in the center of a metropolitan community of about 450,000 population and has an enrollment of approximately 13,000 in grades one to eight, attending 25 separate school units. The sample was selected from Caucasian eighth grade pupils who ranked at the fifth, or at the eighth or ninth local stanines on the California Test of Mental Maturity, Short Form Total IQ (CTMM) and who had complete test results on the California Achievement Tests, Intermediate (CAT). All 93 pupils who had CTMM stanines of eight or nine were included in the study, forming a "high" mental ability group. A total of 121 pupils obtained CTMM stanines of five. Of these, 28 were randomly eliminated to form an "average" mental ability group equal in size to the "high" group.

Procedure

Warner's Index of Status Characteristics (ISC) was used as a measure of socio-economic status. Father's occupation and sources of income were taken from the pupils' cumulative records. Dwelling area rating was derived from a large map of districts which had been subdivided according to Warner's descriptive criteria by the consensual judgments of six district school administrators and supervisors.

Both the CTMM and the CAT were administered in the second month of the eighth grade as part of the regular district testing program. The CTMM IQ's for the 'high" mental ability group ranged from 116 to 142, the "average" group from 97 to 102. The six major sub-tests of the CAT were used as achievement criterion measures.

To obtain a criterion that would be somewhat broader than the results of a standardized achievement test, a teacher rating was obtained for each pupil. Teachers were requested to give a global rating "which reflects your estimate of the pupil's current overall academic achievement." A five-point scale was used with superior achievement given a rating of five and poor achievement a rating of one. Ratings were ob-

* Footnotes appear at the end of the article.

TABLE I

MEANS AND STANDARD DEVIATIONS OF THE VARIABLES FOR "HIGH" AND "AVERAGE" MENTAL ABILITY GROUPS

Variable	Group	Mean	SD
CAT Vocabulary	High	73.39	6.99
	Average	57.87	10.41
CAT Reading Comprehension	High	43.46	4.92
	Average	33.67	7.17
CAT Arithmetic Reasoning	High	40.36	6.34
	Average	29.73	7.88
CAT Arithmetic Fundamentals	High	64.26	10.95
	Average	49.66	11.15
CAT Mechanics of English	High	52.47	5.60
	Average	45.54	7.30
CAT Spelling	High	23.09	6.14
	Average	18.12	6.52
Teacher Rating	High	4.12	0.64
	Average	2.95	0.85
ISC (Warner)	High	44.34	11.51
	Average	59.62	11.63
CTMM	High	121.33	5.35
	Average	99.28	1.59

TABLE II

ANALYSES OF COVARIANCE

Criterion	Residuals			$F_{1,183}$
	Total SS	Within SS	Within MS	
CAT Vocabulary	19,903.37	14,030.60	76.67	76.59
CAT Reading Comprehension	9,856.34	6,960.37	37.97	76.27
CAT Arithmetic Reasoning	12,376.70	9,320.98	50.93	60.00
CAT Arithmetic Fundamentals	27,123.82	21,204.78	115.87	51.08
CAT Mechanics of English	8,995.91	7,737.73	42.28	29.76
CAT Spelling	8,013.25	7,359.84	40.22	16.24
Teacher Rating	145.67	104.27	.57	72.63

tained in the eighth month of the eighth grade.

All relevant data for each S were punched into IBM cards. The means, standard deviations, sums of measures, sums of squares, and sums of cross products of all variables for each mental ability group and for the total sample were computed, using an IBM 704. **

The analysis of covariance was used to control for any group differences in socio-economic status which existed between the two mental ability groups. Thus, mental ability was restricted and socio-economic status was controlled in analyses of covariance involving seven achievement criterion variables.

Results

Table I shows the means and standard deviations of all measures for both groups. Note that on all achievement measures, the "high" ability group has considerably higher mean scores and constitutes a slightly more homogeneous sample. The variance of the "high" ability group may, however, be spuriously curtailed by the "ceiling effect" of the achievement measures involved.

In the case of socio-economic status, note that the lower mean group score denotes high social standing on the ISC. The mean score of the high ability group (44.34) represents a "lower middle class" position on the ISC. The mean rating of the "average" mental ability group (59.62) represents an "upper-lower class" position.

The correlations among the variables were computed. The coefficients are spuriously high since only the tails of the distribution are involved. Nevertheless, the obtained coefficients suggest upper bounds which can be compared with the findings of other studies. Product-moment coefficients were computed between socio-economic status and each of the seven achievement criteria. The r's ranged from a low .23 for Mechanics of English to a high of .47 for Vocabulary. Biserial coefficients were computed between mental ability and all other variables. An r of .68 was obtained between mental ability and socio-economic status. The r's between mental ability and achievement criteria ranged from .46 for Spelling to .82 for Vocabulary.

Table II shows the analysis of covariance data and resulting F-values for each criterion measure. It will be noted that all F-values are statistically significant at the .01 level of confidence. Therefore, the differences in measured achievement of pupils in the "high" mental ability group and pupils in the "average" mental ability group are significant even after adjusting for individual differences in socio-economic status.

Discussion

The results of the study suggest that at least insofar as academic achievement is measured by standardized tests and teacher ratings, intelligence does influence achievement even when differences in socio-economic status have been controlled. However, before one generalizes too widely, the findings of this study should be qualified by several limiting points.

First, the findings might not hold true for all ranges of IQ. The pupils in the "high" mental

ability group might have been bright enough in this school district to "stand out." Possibly, if one compared the stanine seven pupils with the stanine fours rather than the eights and nines with the fives, the results would differ.

A second point concerns the age of the Ss. Were one to study older high school students, or the younger elementary ages, the results might differ from those found with eighth graders. This might be particularly true at the high school level, for it is there that the pupil begins to become more directly involved with the "what the future holds."

A final limiting point concerns the levels of socio-economic status involved in this study. The average ISC for the "high" ability group in this district is at the lower middle class level. Had a greater number of pupils at the higher socio-economic levels been represented, the results might have been different. It should be pointed out, however, that while the central tendency of ISC rating might be considered somewhat low, variability is relatively high.

Summary

The study tested the hypothesis that the academic achievement of pupils with "average" and "high" mental ability does not differ significantly when socio-economic status is controlled. A sample of 186 eighth grade pupils took part in the study. Ss were assigned to a "high" or an "average" mental ability group. Socio-economic status was controlled in analyses of covariance involving seven achievement criterion variables. For each criterion, evidence was obtained to reject the hypothesis at the .01 level. The two mental ability groups differ significantly on all achievement criteria even after adjustments are made for individual differences in socio-economic status.

FOOTNOTES

* Now at Marin County Schools, San Rafael, California.

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